PROXIMAL FEMUR NAILING FOR UNSTABLE SUB TROCHANTERIC AND INTER TROCHANTERIC FRACTURES

Dissertation submitted in

Partial fulfilment of the regulations required for the award of

M.S. Degree in Orthopaedics

THE TAMIL NADU Dr M.G.R. MEDICAL UNIVERSITY

CHENNAI, TAMIL NADU

April 2015

CERTIFICATE

This is to certify that the dissertation entitled "**PROXIMAL FEMUR NAILING FOR UNSTABLE SUB TROCHANTERIC AND INTER TROCHANTERIC FRACTURES** " is a bonafide and genuine research work Carried out by **Dr. Syed Bakhar .S** in partial fulfilment of the requirement for the degree of Master of Surgery in Orthopaedics

Date: **Prof. Dr. S. Elangovan**

Guide, Dept of Orthopaedics

Place **Coimbatore Medical College Hospital**

Date:

HOD, Dept of Orthopaedics

Place **Coimbatore Medical College Hospital**

The Dean

Date: **Coimbatore Medical College Hospital**

Place:

DECLARATION

I declare that this dissertation titled "**PROXIMAL FEMUR NAILING FOR UNSTABLE SUB TROCHANTERIC AND INTER TROCHANTERIC FRACTURES**" has been prepared by me, at Coimbatore Medical College Hospital under the guidance of **Prof. Dr. S. Elangovan** Coimbatore Medical College Hospital, Coimbatore, in partial fulfilment of Dr. M.G.R. Tamilnadu Medical University, regulations for the award of M.S. Degree in Orthopaedics.

I have not submitted this dissertation to any other university for the award of any degree or diploma previously.

Place:

Date:

Dr. Syed Bakhar S

Post graduate in Orthopaedics,

Coimbatore Medical College Hospital,

Coimbatore.

ACKNOWLEDGEMENT

It gives me great satisfaction and pleasure in completing this dissertation.

Firstly I sincerely thank **Dr. S. Revwathy M.D., D.G.O., DNB Dean-Coimbatore Medical College** for permitting me to do this research work.

I express my deep sense of gratitude & heartfelt thanks to **Prof. Dr. S. Elangovan,** of Orthopaedics, Coimbatore Medical College Hospital, Coimbatore for his valuable guidance and constant encouragement in bringing out this dissertation.

I also express my sincere thanks to **Prof. Dr. S. Dhandapani** and **Prof. Dr. S. Vetrivel Chezian** for their guidance and suggestions during this dissertation. I sincerely thank all my assistant Professors namely **Dr. M. S. Mugundhan, Dr.K.Gajendran, Dr. P. Balamurugan, Dr.K.S. Maheswaran, Dr. Major. K. Kamalanathan, Dr. Marimuthu** for helping me bringing out this dissertation.

I also thank my wife, my colleagues, staff nurses and other members of the Department of Orthopaedics, Coimbatore Medical college Hospital for their help.

Lastly, my sincere thanks to all my beloved patients and their attenders, with their excellent co-operation became the backbone of this dissertation.

Dr. Syed Bakhar S,

M. S. Ortho Postgraduate.

ABSTRACT

PROXIMAL FEMUR NAILING FOR UNSTABLE SUB TROCHANTERIC AND INTER TROCHANTERIC FRACTURES

Introduction : Treatment of unstable trochanteric fractures is always challenging. Dynamic Hip Screw and Dynamic Condylar Screw have been used for a long time with great success. However both DHS and DCS requires relatively larger skin incision, more tissue handling, all of which increases the probability of infection, blood loss, operating time.Varus collapse of the fracture, non union and implant failure are also commonly seen with DHS fixation. Since this device performed less well in unstable trochanteric fractures,with high rates of failure, intramedullary fixation devices have become increasingly popular.The main principle of this type of fixation is based on a sliding screw in the femoral neck-head fragment, attached to an intra- medullary nail.

In 1996 AO/ASIF came up with new cephalomedullary reconstruction nail (Proximal femur nail) with trochanteric entry port.This nail have shown to be biomechanically stronger than DHS fixation and other modalities of fixation.Moreover Proximal Femoral Nail have also reduced the chances of infection,blood loss,morbidity and patients were allowed early weight bearing.

Materials and methods: This is a prospective,non randomised control study conducted in Coimbatore Medical College & Hospital. 20 Patients with unstable Inter trochanteric and subtrochanteric fractures who met our inclusion criteria were selected.Clinical assessment of the patients were done in detail.Basic blood investigations were done, X-rays of involved hip with thigh taken.Fractures were classified by Seinsheimers, and Boyd and Griffin Classification.Detailed informed consent obtained.Open reduction done only when not able to achieve closed reduction.Both short and long Proximal femur nail were used depending upon the needs.Post operatively patients were mobilised immediately,full weight bearing started only after radiological union of fracture.Patients were post operatively evaluated with modified Harris Hip Score.

Results : In our study,mean age of the patient was 55.18 yrs,6 cases were of type 2 fractures , 4 cases were type 3 A fracture. As assessed by modified Harris hip score, excellent to fair results were obtained at 12 months follow up in 16 cases ,4 cases had poor results.. Two patient s had superficial infection,one had deep infection who was treated with i.v. antibiotics. 6 patients had limb shortening of 2 cms, varus malunion seen in one patient with Z effect.

Conclusion: Proximal femur nail has widened the indication of intra medullary nailing for more complex fractures of the proximal femur.By doing closed reduction ,it offers a minimal soft tissue damage,preserves the fracture hematoma,decreased blood loss and reduces the operating time.Though complications were reported, still it holds good,with good surgical hands because the procedure is technically demanding and needs a steep learning curve.

CONTENTS

Coimbatore Medical College

COIMBATORE, TAMILNADU, INDIA - 641 014

(Affiliated to The Tamilnadu Dr. MGR Medical University, Chennai)

ETHICS COMMITTEE

CERTIFICATE

Name of the Candidate : SYED BAKHAR

Course : M.S ORTHOPAEDICS

Period of Study : 2012 - 2015

College : COIMBATORE MEDICAL COLLEGE

Dissertation Topic : PROXIMAL FEMUR NAILING FOR UNSTABLE SUB TROCHANTERIC AND INTER TROCHANTERIC FRACTURE

The Ethics Committee, Coimbatore Medical College has decided to inform that your Dissertation Proposal is accepted / ~~Not accepted~~ and you are permitted / ~~Not permitted~~ to proceed with the above Study.

DEAN

Coimbatore Medical College & Hospital,
Coimbatore

turnitin

Digital Receipt

This receipt acknowledges that Turnitin received your paper. Below you will find the receipt information regarding your submission.

The first page of your submissions is displayed below.

Submission author:	221212253.ms Orthopaedics SYED ..
Assignment title:	TNMGRMU EXAMINATIONS
Submission title:	PROXIMAL FEMUR NAILING FOR U..
File name:	Full_Thesis.docx
File size:	6.24M
Page count:	125
Word count:	10,548
Character count:	58,636
Submission date:	28-Sep-2014 01:05PM
Submission ID:	454418482


PROXIMAL FEMUR NAILING FOR UNSTABLE
SUB TROCHANTERIC AND INTER
TROCHANTERIC FRACTURES

THE TAMIL NADU Dr. M.G.R. MEDICAL UNIVERSITY
CHENNAI, TAMIL NADU


Turnitin Document Viewer - Google Chrome
https://turnitin.com/dv?o=454418482&u=1031434379&s=&student_user=1&lang=en_us
PROXIMAL FEMUR NAILING FOR UNSTABLE SUB TROCHANTERIC AND INTER TROCHANTERIC FRACTURES
turnitin
18%
Match Overview
PROXIMAL FEMUR NAILING FOR UNSTABLE
SUB TROCHANTERIC AND INTER
TROCHANTERIC FRACTURES
Dissertation submitted in
Partial fulfilment of the regulations required for the award of
M.S. Degree in Orthopaedics
THE TAMIL NADU Dr M.G.R. MEDICAL
1 Pelvis and Lower Lim... 1%
2 www.inch-orth.com 1%
3 www.authorstream.com 1%
4 www.ltee.com 1%
5 tracomagna.org 1%
6 Geder, L. "(a) The dif... 1%
7 www.sofcot.org.fr 1%
8 www.ijponline.com 1%
9 www.jpaonline.org 1%
10 lib.bioinfo.pl 1%
11 Rajasekaran, Shanmu... 1%
12 sanveone.dig.uned.es <1%
start

INTRODUCTION

There is a worldwide increase in the incidence of intertrochanteric fracture and sub trochanteric fractures. Intertrochanteric fracture[1] is defined as the fracture extending from the extra-capsular basilar neck region to region along the lesser trochanter before medullary canal development.Where as Sub trochanteric[2] femur fracture is fracture between lesser trochanter and a point 5cm distal to lesser trochanter. These fractures are seen in old patients following low energy trauma or in the young individuals, the mechanism of injury is almost always high-energy trauma, either from direct trauma (e.g. motor vehicle accident) or from axial loading (e.g. a fall from height).

Treatment of unstable trochanteric fractures is always challenging. Dynamic Hip Screw[3] and Dynamic Condylar Screw have been used for a long time with great success.However both DHS and DCS requires relatively larger skin incision,more tissue handling,all of which increases the probability of infection,blood loss,operating time.Varus collapse of the fracture,non union and implant failure are also commonly seen with DHS fixation. Since this device performed less well in unstable trochanteric fractures,with high rates of failure, intramedullary fixation devices have become increasingly popular.The main principle of this type of fixation is based on a sliding screw in the femoral neck-head fragment, attached to an intra- medullary nail.

In 1996 AO/ASIF came up with new cephalomedullary reconstruction nail [4] with trochanteric entry port. This nail have shown to be biomechanically stronger than DHS fixation and other modalities of fixation. Moreover Proximal Femoral Nail have also reduced the chances of infection, blood loss, morbidity and patients were allowed early weight bearing.

This study evaluates the role of Proximal Femoral Nail in unstable trochanteric and sub trochanteric fractures.

AIM:

To analyse the clinical and functional outcome of unstable intertrochanteric and sub trochanteric fractures treated with Proximal Femoral Nail.

HISTORICAL REVIEW

Prior to the year 1930, trochanter fracture management was conservative treatment basically.

In the year 1907, Fritz Steinmann, of Bern, devised a method to apply skeletal traction. He inserted two pins into the femoral condyles and applied traction.

In the year 1909, Martin Kirschner, of Greifswald, introduced small diameter stainless steel wires, which were inserted through and through to apply skeletal traction. But they were insufficiently rigid.

In the year 1916, Steinmann introduced the Steinmann pins, which were rigid stainless steel pins of 9 inches length and 3-5 mm diameter.

In the year 1929, Bohler of Austria developed a special stirrup that could be attached to the Steinmann pin and helped in varying the direction of traction without rotating the pin in the bone.

In the year 1930, Jewett [5] introduced the nail, which came to be known as Jewett nail, which could be inserted into the fracture through the greater trochanter to provide stability of fragments.

Jewet nail:

In the year 1931, Smith-Peterson[6] introduced the triflanged nail for treatment offracture neck of femur and trochanter fractures.

In the year 1932, Roger Anderson described a traction method where skeletal traction was applied to the injured leg while the well leg was employed for countertraction.

In the year 1932, Johansson introduced the cannulated hip nail which was later modified by West Cott. This helped in more accurate placement of the nail in the femoral head. This was the precursor of guide pins used currently.

Since the year 1934, Austin T.Moore started studying proximal femoral fractures in detail. He began treating intertrochanteric fractures with nailing.

In the year 1937, Lawson Thornton modified the Smith-Peterson nail by attaching a plate to the nail. This plate came to be known as Thornton plate.

In the year 1940, Austin Moore developed an implant which held the trochanteric fracture by a blade through the fracture into the head of the femur and a plate fixed to the shaft of the femur held with screws. It was made of steel, was 8 inches long and angled at 135° to correspond to the neck-shaft angle of the femur.

Milwaukee suggested its use for the proximal femoral osteotomies at 95° angle also and it was named ‘blade plate’.

In the year 1941, Jewett[5] developed a new implant modifying the Jewett nail by devising a single piece angled nail plate for an open reduction and internal fixation of intertrochanteric fractures.

In the year 1944, Austin Moore published a report about internal fixation of intertrochanteric fractures with blade- plate. He advocated the operative treatment stating that it decreased convalescence, hospital and nursing care expenses and improved functional recovery. He also stated that the length and shape of the blade plate could be altered to suit different needs in various conditions of proximal femur fractures.

In the year 1947, Irwin A. Jaslow published a case report of blade-plate fixation for trochanter fracture and advocated the use of blade-plate and mentioned about peri-prosthetic fracture and its management.

In the year 1947, McLaughlin introduced an adjustable nail plate combination.He used a triflanged nail with its lateral end having a slot to which a plate was fixed with a washer and bolt.

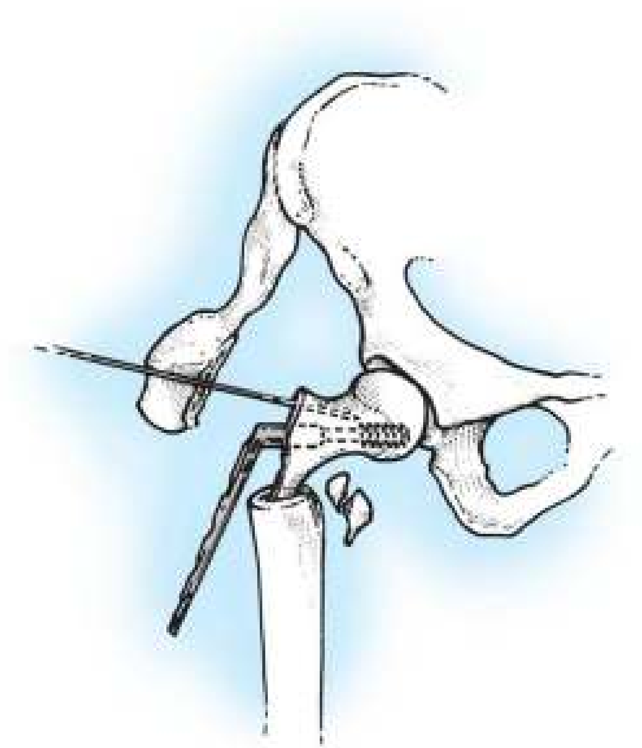
In the year 1949, Harold B.Boyd and Lawrence L.Griffin[7] presented a paper regarding their study of 300 intertrochanteric fractures of femur in which they gave a classification based on prognosis and the difficulty of securing and maintaining reduction. They concluded that internal fixation results were comparable to results following non-operative management.

In the year 1949, Mervin Evans[8] presented 123 cases of which 101 were treated conservatively and 22 cases were treated with internal fixation with Capener Neufeld nail plates. He suggested that operative management had the advantages of early mobility and decreased mortality. He also devised a classification system in which he divided the trochanteric fractures into stable and unstable types.

In the year 1950, GP Arden and GJ Walley studied a series of 37 intertrochanteric fractures treated by internal fixation. They opined that operative treatment had the advantages of early ambulation, fewer general complications, shorter hospital stay and earlier return to normal function.

In the year 1960, the USA based ‘Richards manufacturing company’ produced dynamic compression screw. Hence, it came to be known as ‘Richards screw[9]. Clawson made several modifications and in its current form, the device is known as Richards Compression Screw.

In the year 1967, Dimon and Hughston[10] evolved a new method of fixation termed primary medial displacement osteotomy [PMDO]. This prevented the cut-out of the implant and the collapse of the fracture in varus position.

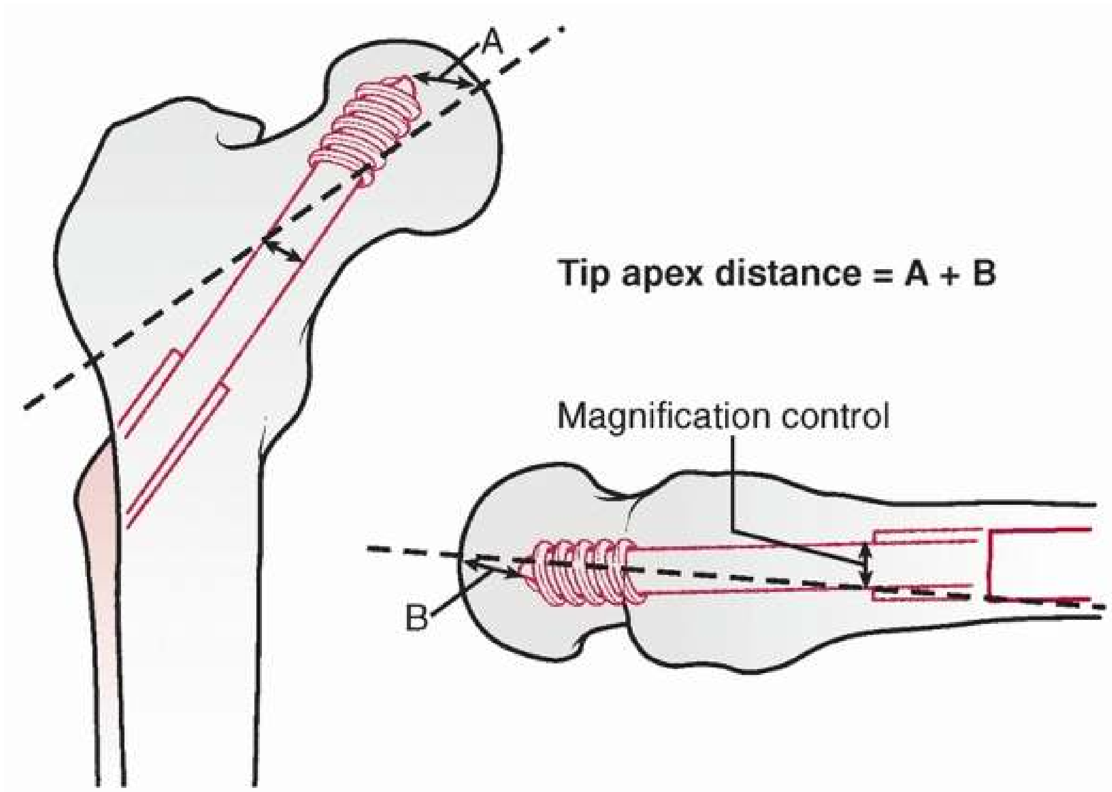


In the year 1970, Singh[11] et al described the trabecular pattern of the upper end of the femur and the changes noted in the trabecular pattern as an index of osteoporosis.

In the year 1973, Mann RJ published his study on the avascular necrosis of the femoral head following intertrochanteric fractures and concluded that though the risk of avascular necrosis was very small, it was definite and needed a high degree of clinical suspicion and should be diagnosed as early as possible for better outcomes.

In the year 1973, Augusto Sarmiento[12] emphasized that the reduction of the medial cortex determines the efficiency of the metallic appliances. After accurate reduction of the medial cortex, fracture can withstand great stresses, while improper reduction of medial cortex resulted in collapse into varus with implant failure. He also stated that osteotomy gives maximal stability and changes the angle of inclination of the fracture to a less vertical degree introducing a valgus attitude to the proximal femur.

Baumgaertner et al [41]. concluded that if the tip apex distance (both in antero posterior and lateral view) was less than 25 mm,the chances of cut out of lag screws was minimized.



The Medoff plate[13] is a biaxial compression plate and screw system.One along the lag screw which incorporates the head and the other long axis of the femur. Medoff plate has a plate and lag screw in its proximal part which allows compression along one axis and with a separate side plate that s securely fixed to the lateral femur. This biplanar compression provides theoretical advantages for more complex proximal femur fractures.

The unstable intertrochanteric, high sub trochanteric fractures are the indications for Medoff plate system.. If the proximal fracture fragment is long and is fixed to the slide plate by the proximal cortical plate screw, no sliding occurs. The Medoff sliding plate gives surgeon the option of three different compression modes for the treatment of extracapsular hip fractures.

1) In high subtrochanteric fractures and those trochanteric fractures with reverse oblique pattern can be managed with uniaxial compresssion.

2) Medial displacement of the proximal fragment and migration of lag screw into the head can be minimized by biaxial dynamisation.This mode of dynamisation is very useful in fractures with a complete plate slide and risk of lag screw migration, which is most frequently seen in unstable intertrochanteric and subtrochanteric fractures.

3) Biaxial dynamisation is indicated in the treatment of most unstable intertrochanteric fractures but may also be used in subtrochanteric fractures where lateral wall of proximal femur is breached out.

By using the right dynamisation mode of the Medoff plate[14], it is possible to achieve good anatomical reduction and reduce implant failure.

In the mid-to-late 1970's, flexible intramedullary devices for the fixation of intertrochanteric fractures were introduced in the form of the Ender's nail[15] and the condylocephalic nail. The advantage of these devices was due to their intramedullary position, which places them closer to the resultant force across the fracture and reduces the bending moment on the device. In addition, the use of distal sites of insertion to decrease operative time and loss of blood, compared with the use of proximal sites, was reported. This operative technique was made possible by the use of image intensification and was promoted as a closed method for the fixation of intertrochanteric fractures. However, a high prevalence of varus deformity, as well as pain in the knee caused by distal migration of the pins, were reported in association with this procedure. These problems led to a high rate of re-operation for extraction of the pins and correction of deformity. A high rate of failure due to loss of reduction, shortening, and external rotation resulted both from Ender's nails and from condylocephalic nails. Accordingly, most authors have recommended that these devices not to be used for the fixation of unstable trochanteric fractures.

A,B

The reduced lever arm which aids in combating the tensile forces and facilitates increased load transfer offers the intramedullary[4] devices to act as a better option in complex proximal femur fractures. Moreover the incidences of closed reduction which is more commonly seen in intramedullary nails benefits the the patient with small skin incision,reduced blood loss and minimal operating time there by decreasing the chances of infection.

Gamma nail[16] is a versatile implant for fixation of trochanteric and sub trochanteric fractures. Development of this nail progressed through various designs. Initial design was called as Mark I.Subsequent designs that followed were called Mark II and Mark III.Initially it was called as

Halifax Nail after the place where it was developed by Dr.Subhash Haldar.A group of surgeon from Strasbourg changed the name of this nail to a universal one ie;Gamma Nail as the shape resembled the Greek letter gamma.

GAMMA NAIL

However these intramedullary devices are not without complications. Increased proximal bend without anterior bowing and increased proximal and distal diameter of the nail have resulted in increased stress over the tip of the nail.This leads to high incidence of implant failure.Also the prevalence of screw breakage and screw cut out was more with these first generation implants.

Second generation nails have came with a different configuration ,which suits more for the unstable trochanteric fractures. These implants had a relatively less rate of implant related failure.

The more recently introduced Proximal femur nail[17] has a modification in the geometry of the nail .This nail has a reduced proximal diameter and a reduced valgus bend.Also it has two screw fixation options into the head of femur.One large lag screw and another small anti rotation screw.This allows the nail a better option for the management of various complex femur fractures.This small diameter of the nail also reduces the stress concentration at the tip of the nail and prevents the incidence of peri prosthetic fractures.However screw cut out has been seen with the use of smaller diameter antirotation screws.This is due to the fact that maximum load sharing is done by the large lag screw, where as the smaller diameter hip screw is designed for rotational stability.

REVIEW OF LITERATURE

W. M. Gadegone & Y. S. Salphale[17] ,in 2006, reported a study on Proximal femoral nail – an analysis of 110 cases of proximal femoral fractures with an average follow up of 2 year. Postoperative radiographs showed a near-anatomical fracture reduction in 90% of his patients.. The fracture consolidated in 4 months.Patients were allowed early weight bearing.

Metin Uzun[18] et al, in 2010, In a study of 40 patients reported effects on functional results following treatment of unstable intertrochanteric femoral fractures with the proximal femoral nail . Reduction was assessed as good or acceptable in all the patients. Complete union was achieved in all but except three patients . The mean Harris hip score in his series was 84.

Simmermacher et al[19] in 2000,in a his multicentric study concluded that anatomical fracture reduction was found in 86% of the patients ,cut out of the neck screw occurred in 0.6% cases.

Lei-Sheng Jiang [20] et al (2002) in his study of clinical outcome of 50 traumatic sub trochanteric fractures treated with long proximal femoral nail concluded that Proximal femur nail is a better implant for sub trochanteric fractures leading to high rate of bone union and minimal morbidity.

Deepinderjit Singh[21] et al (2012) in his study of 25 patients with sub trochanteric fractures reported that PFN is a good implant for stabilizing subtrochanteric fractures of femur as it allows early rehabilitation and weight bearing while allowing for early union of the fracture.

Shisihir Murugharaj[22] (2009) in his study of comparision of Proximal Femur Nail versus Dynamic Hip Screw for the management of sub trochanteric fractures stated that nailing has the advantage of providing rotational and axial stability and allowing earlier post operative rehabilitation.

A S Sidhu[23] (2010) in his study of 30 cases with Proximal Femoral Nail - A Minimally Invasive Method for Stabilization of Pertrochanteric and Subtrochanteric Femoral Fractures concluded that PFN is an evolving approach to treat intertrochanteric and high subtrochanteric femoral fractures in a minimally invasive fashion and indicates PFN to be a safe and successful implant. Varus collapse, difficulty in placement of neck/hip pin screws and intra articular migration of neck /hip pin screw might be the complications in very few cases which can be minimized after proper fracture reduction and postoperative rehabilitation.

Christian Boldin[24], Franz J. Seibert et al in 2000 carried a prospective study 55 patients having proximal femoral fractures treated with the proximal femoral nail. They achieved good results in most of the patients with very less complications at 12 month follow up. They concluded that proximal femoral nail is a good minimal invasive implant for unstable proximal femoral fractures.

Pajarinen J[25]. et al performed a randomised clinical trial comparing the Dynamic hip screw and proximal femoral nail in patients with pertrochanteric fractures emphasizing functional outcomes and rehabilitation. At four months review patients treated with proximal femoral nail regained their pre-injury walking ability. Shortening of the both femoral neck and shaft was seen in patients treated with Dynamic hip screw, this difference was statistically significant.

Kilinger H[26]**.** M et al have done a comparative study of 173 unstable intertrochnateric femoral fractures treated with Dynamic hip screw and trochanteric butters plate Vs proximal femoral nail .In case of proximal femoral nail only 2% revisions were necessary and in the case of dynamic hip screw with TBPP 21.6%. A shorter operation time and a considerable shorter in patient stay were common features with proximal femoral nail. They concluded that Dynamic hip screw with TBPP had a higher incidence of complications in unstable trochanteric fractures than proximal femoral nail.

Reska M[27] et al reviewed 83 patients with proximal femoral fractures treated with proximal femoral nail. In their study except for 2 cases post- operative course was favourable in rest of the patients. They concluded a careful surgical approach and technique with skill have markedly contributed to a more rapid mobilization of a patient with the use of proximal femoral nail.

Pavelka T[28]. et al reviewed 79 patients with ipsilateral fractures of the hip and shaft treated with a long proximal femoral nail. In follow up for at least 12 months bone union was achieved in all patients. The outcomes were excellent in 64%, good in 28% and satisfactory in 8%. They concluded that the long proximal femoral nail is, a high quality implant that increases our options for treatment of all complex fractures .

In 2002 a study by **Banan** et al reported that PFN is a good choice of implant for sub trochanteric fractures and the results are encouraging.

In 2003,**Ramakrishnan**[30] et al stated that long proximal femur nails used for ipsilateral trochanteric and shaft fractures had a good clinical and radiological outcome.

S.Nuber [31]et al in 2003 in his study of Proximal femur nailing for unstable trochanteric fractures concluded that proximal femoral nail is better implant in reducing the amount of blood loss and stable fixation when compared to DHS.

In 2004,**Steinberg**[32] et al studied the biomechanics of the subtrochanteric fractures and concluded that proximal femur nail with multiple fixation to be more effective in the management of such complex fractures .Also the fluting tip of the nail reduces the stress fractures.

According to **Rosenblum**[33] and his group,intramedullary devices like proximal femur nail ,gamma nail provided three point fixation,more efficient load transfer due to its medial location with a shorter lever arm and hence less tensile strength on the implant,reducing the risk of mechanical failure of the implant.

Harris, I Rahme, D compared the fixation failure rate in subtrochanteric fractures treated with 95 degree blade plate with proximal femur nail.There was 25 % fixation failure in 95 blade plate group,whereas there is no failures in the PFN group.

Anatomy of Proximal Femur:

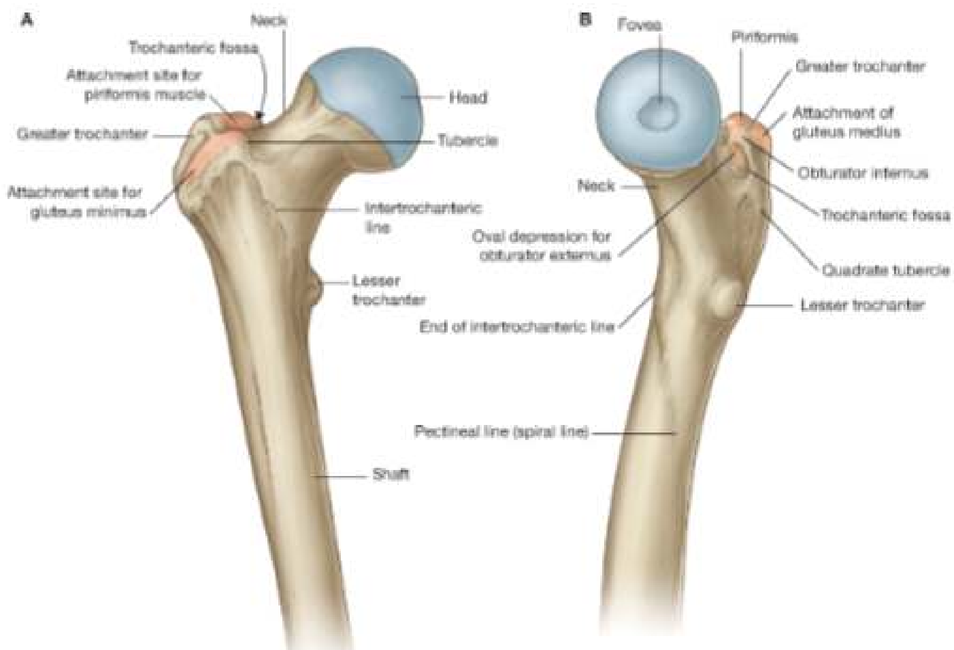
The proximal femur comprises of the head, neck, a greater and a lesser trochanter.

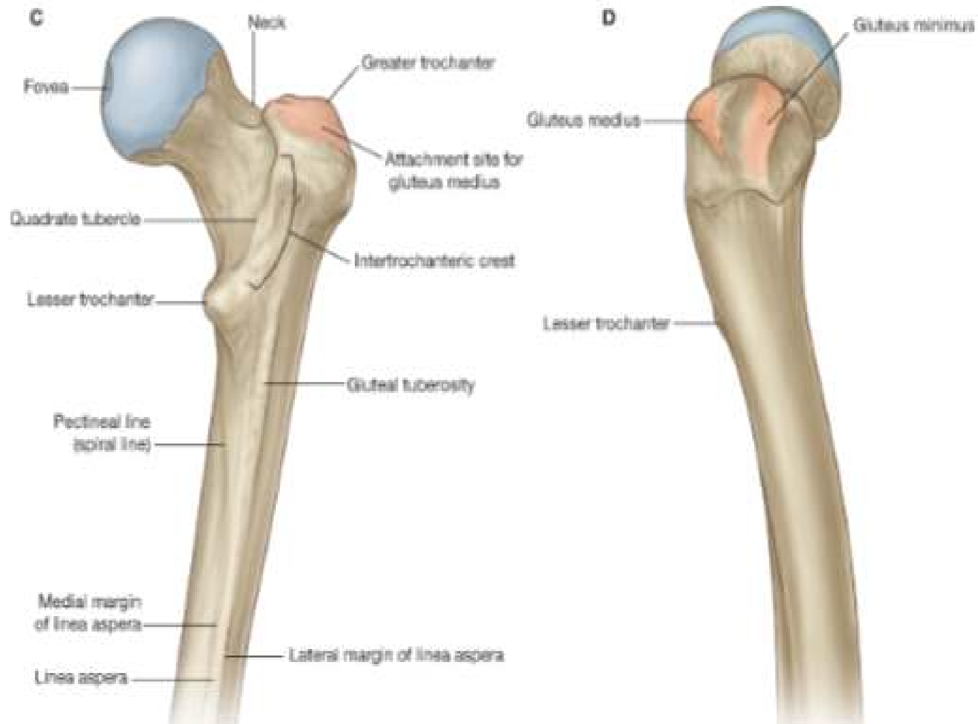
The **femoral head** is more like hemispherical in shape directed upwards, medially, and slightly forwards to articulate with the acetabulum.

The **neck** connects the head and the shaft with which it forms an angle of 120 to 135 degrees, roughly pyramidal in shape, flattened anteriorly and at its junction of the shaft is marked by a prominent rough ridge termed the intertrochanteric line. A rounded ridge termed the intertrochanteric crest, which joins the posterior aspect of the greater trochanter to the lesser trochanter, marks the posterior surface at its junction with the shaft. Quadrate tubercle is a rounded protuberance present on the upper part of the crest.

The **greater trochanter** is a large quadrangular projection, laterally positioned at junction of the femoral neck with the shaft. Its medial surface presents a roughened depressed area, the trochanteric fossa. Most of the gluteal muscles are inserted on the greater trochanter.

The **lesser trochanter** is conical shaped, projects medially off the posteriomedial surface of the femur and gives attachment to the psoas major at its summit, and iliacus at its base. The upper fibers of adductor magnus insert on its posterior surface.





Muscles around the hip joint

The Abductors

These muscles are the gluteus medius & gluteus minimus.They originate from the outer table of the ilium and insert into the greater tuberosity. They are supplied by superior gluteal nerve.The tensor fascia lata arises from the outer border of the iliac crest & inserts on the iliotibial band. The gluteus muscles control the pelvic tilt in the frontal plane.

The flexors

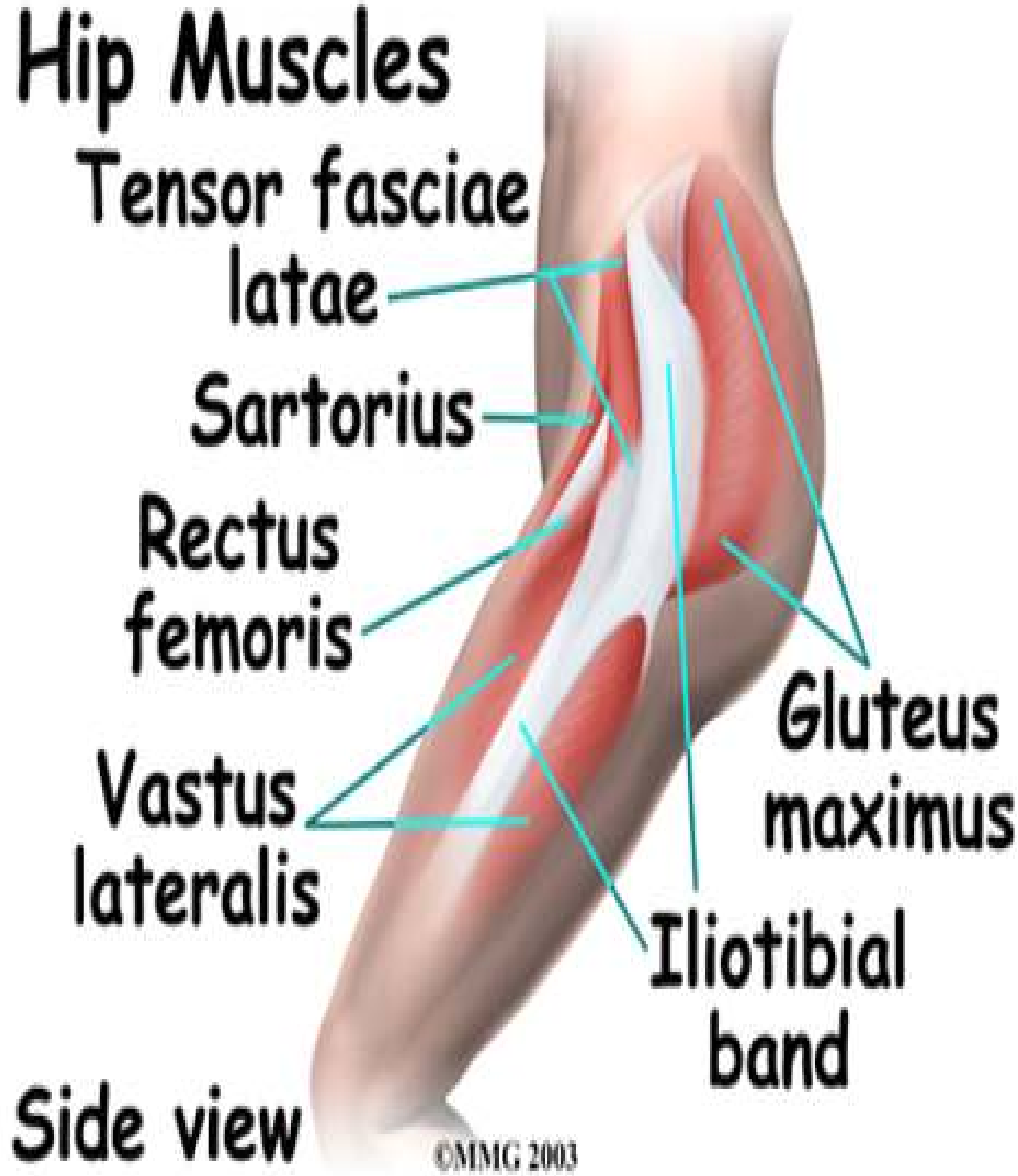
The iliopsoas inserts on the lesser trochanter. It is responsible for the displacement of the fragment is highly unstable fracture.

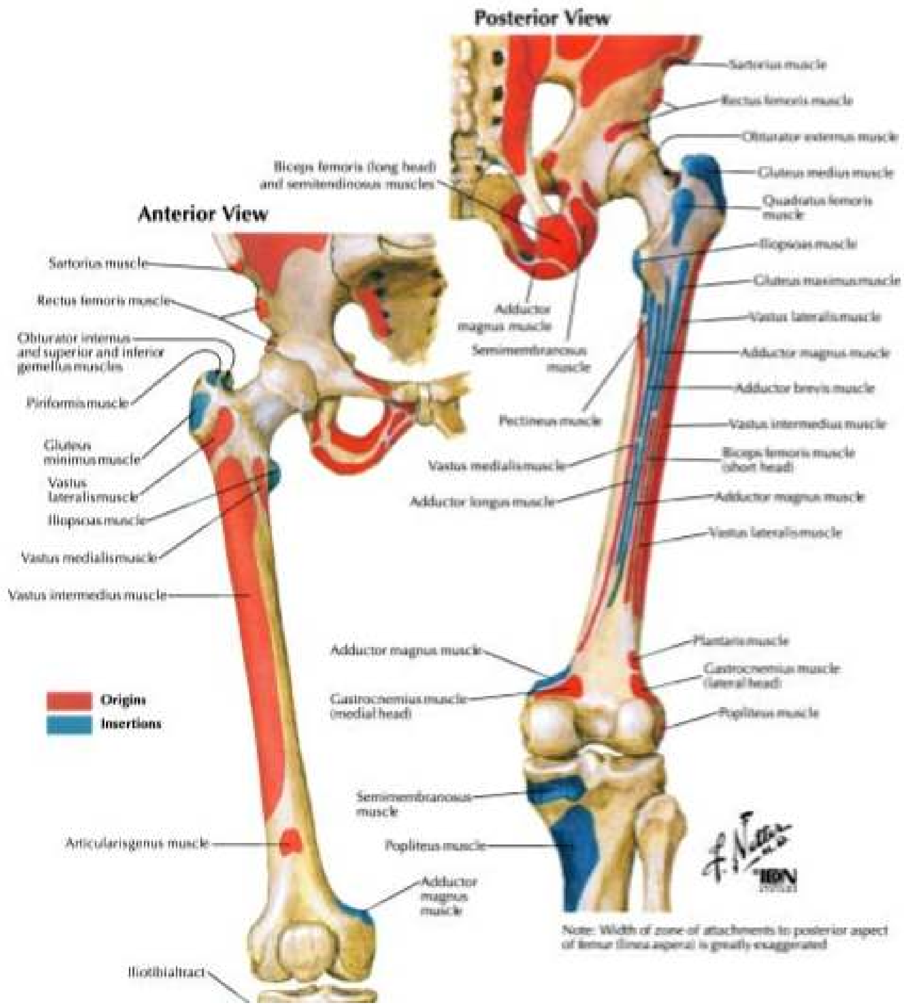
The short external rotators

These muscles include the pirformis, obturator iriternus, obturator externus, superior and inferior gamelli and quadratus femoris. They insert along the posterior aspect of the inter trochanteric crest.

Gluteus maximus

This is the largest muscle of the body. It arises from the ilium, sacrum and coccyx and inserts into the iliotibial band and the gluteal tuberosity. Its main action is the extension of hip joint,with external rotation .


Hip Muscles
Tensor fasciae latae
Sartorius
Rectus femoris
Vastus lateralis
Gluteus maximus
Iliotibial band
Side view
©MMG 2003



Blood supply of proximal femur

Extra capsular arteries to upper end of arises from,

1. Medial circumflex femoral artery. (which branch into)

a. Lateral epiphyseal artery

b. Superior metaphyseal artery

c. Inferior metaphyseal artery (supply head derived from metaphysic)

2. Lateral circumflex femoral artery

3. Superior gluteal artery

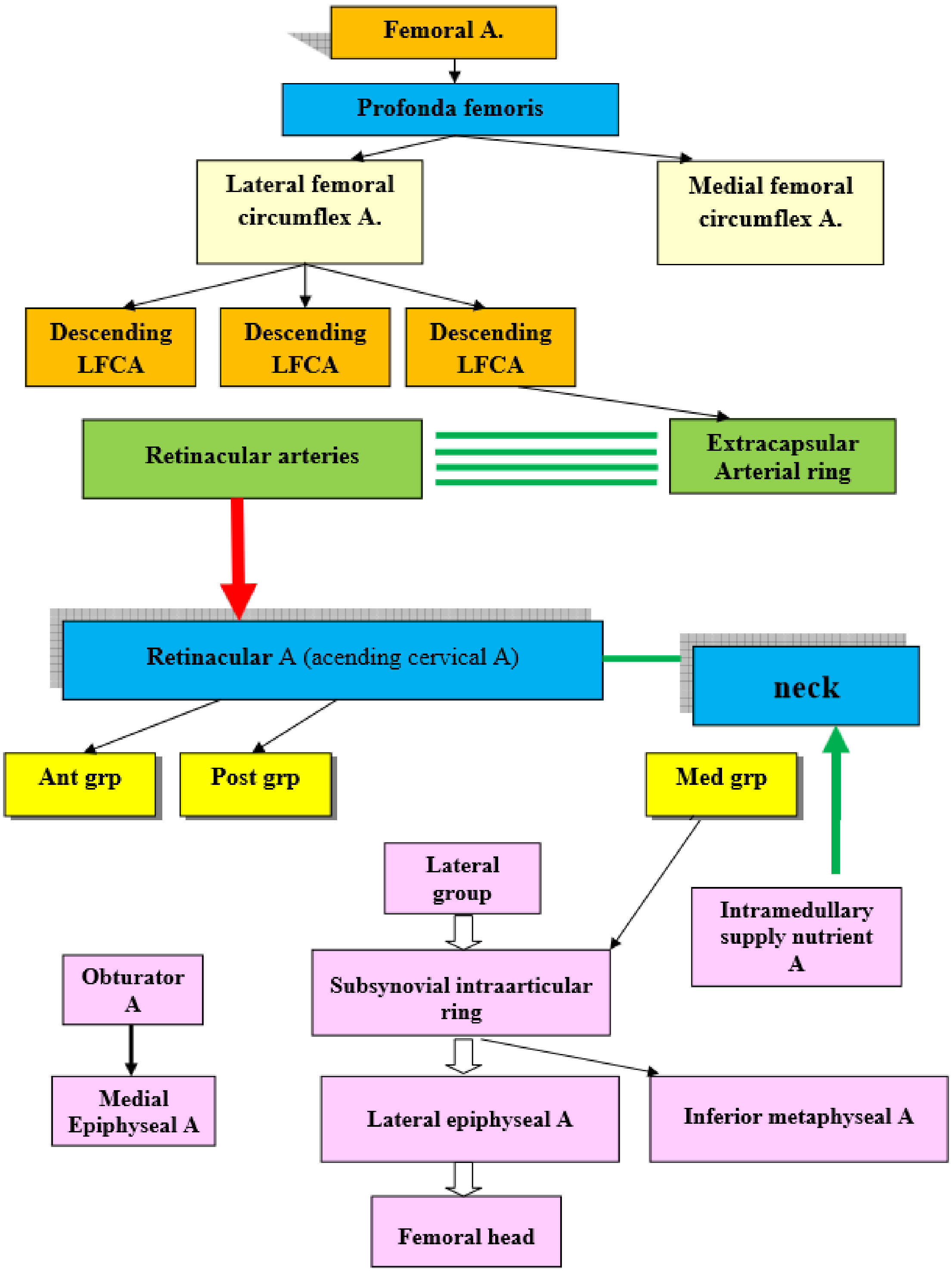
4. Obturator artery, Medial epiphyseal artery (artery of ligamentum teres branch from acetabular artery).

5. First perforating branch of profunda femoris artery.

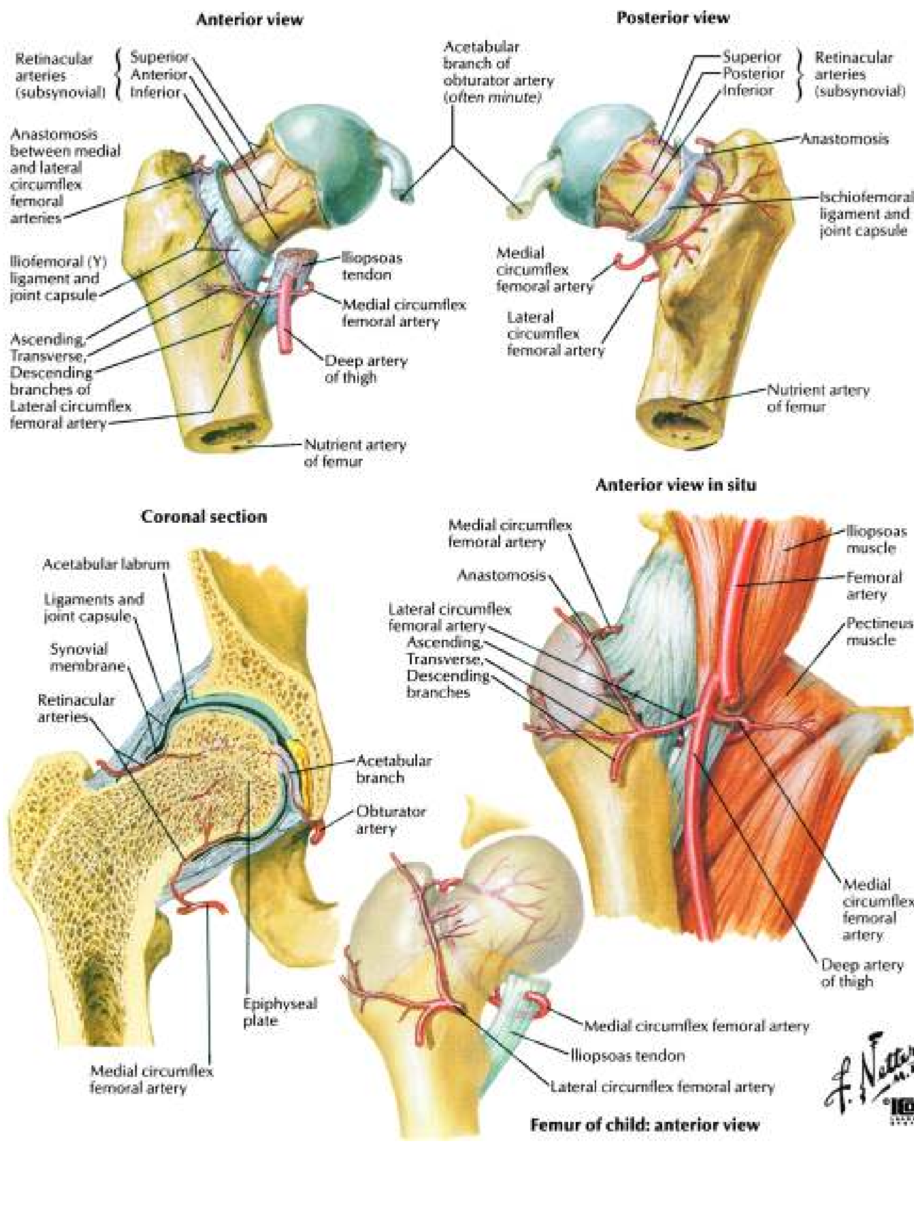
6. Second and third perforating branch of profunda femoris artery

Arteries to the head and to major portion of neck are derived from both femoral circumflex arteries and to a variable degree from acetabular branch from Obturator artery. Acetabular branches passes through the acetabular notch to supply soft tissue in acetabular fossa, send branches into the hip-bone and send one or more branches (artery of ligamentum teres of foveolar artery) to the head through ligament of teres.

Lateral epiphyseal arteries supply 2/3rd of femoral head in adult. In subcapital fractures, metaphyseal vessels are torn when head fragment is grossly dispiated, which places the head at risk of viability. Medial epiphyseal vessels[34] alone is left to supply the head, if lateral epiphyseal and metaphyseal vessels are involved, and is usually unable to maintain the viability of head. Vessels to capsule of the hip joint are branches that supply upper end of femur.


Femoral A.
Profonda femoris
Lateral femoral circumflex A.
Medial femoral circumflex A.
Descending LFCA
Descending LFCA
Descending LFCA
Retinacular arteries
Extracapsular Arterial ring
Retinacular A (acending cervical A)
neck
Ant grp
Post grp
Med grp
Lateral group
Intramedullary supply nutrient A
Obturator A
Subsynovial intraarticular ring
Medial Epiphyseal A
Lateral epiphyseal A
Inferior metaphyseal A
Femoral head

VASCULAR ANATOMY



TRABECULAR ANATOMY :

If the femur is sectioned in the frontal plane, the orientation of trabeculae[11] can be visualized.

There are 2 principle trabecular systems.

1.Principle compressive trabeculae:

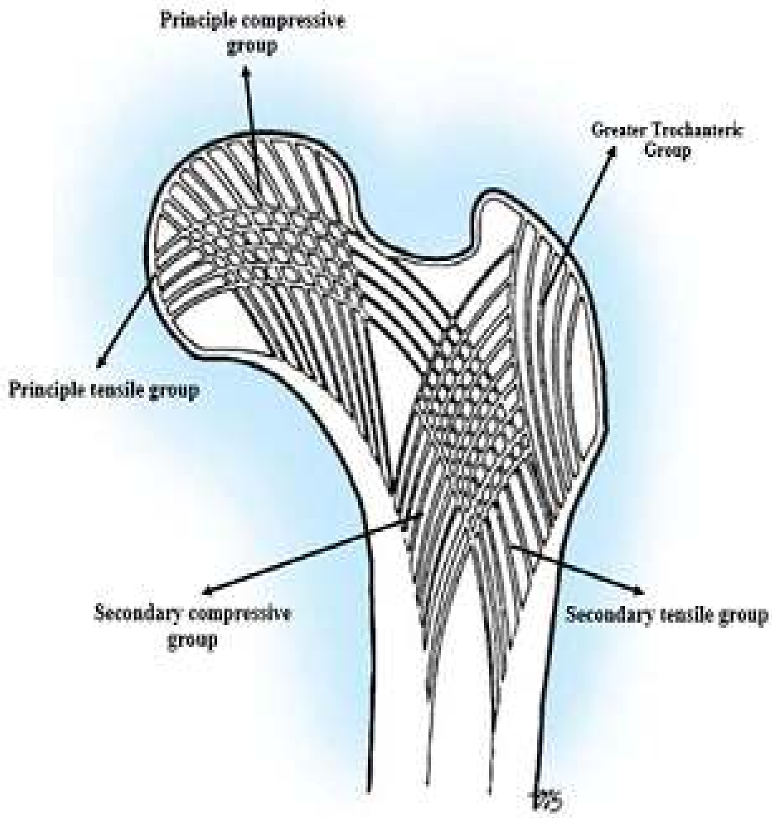
These arise from the medial cortex of femoral shaft and extend into the weight bearing region of the femoral head. These are the most dense and strongest of all the trabecular systems. They form an angle of 160 degrees with the medial cortex of the shaft (trabecular angle).

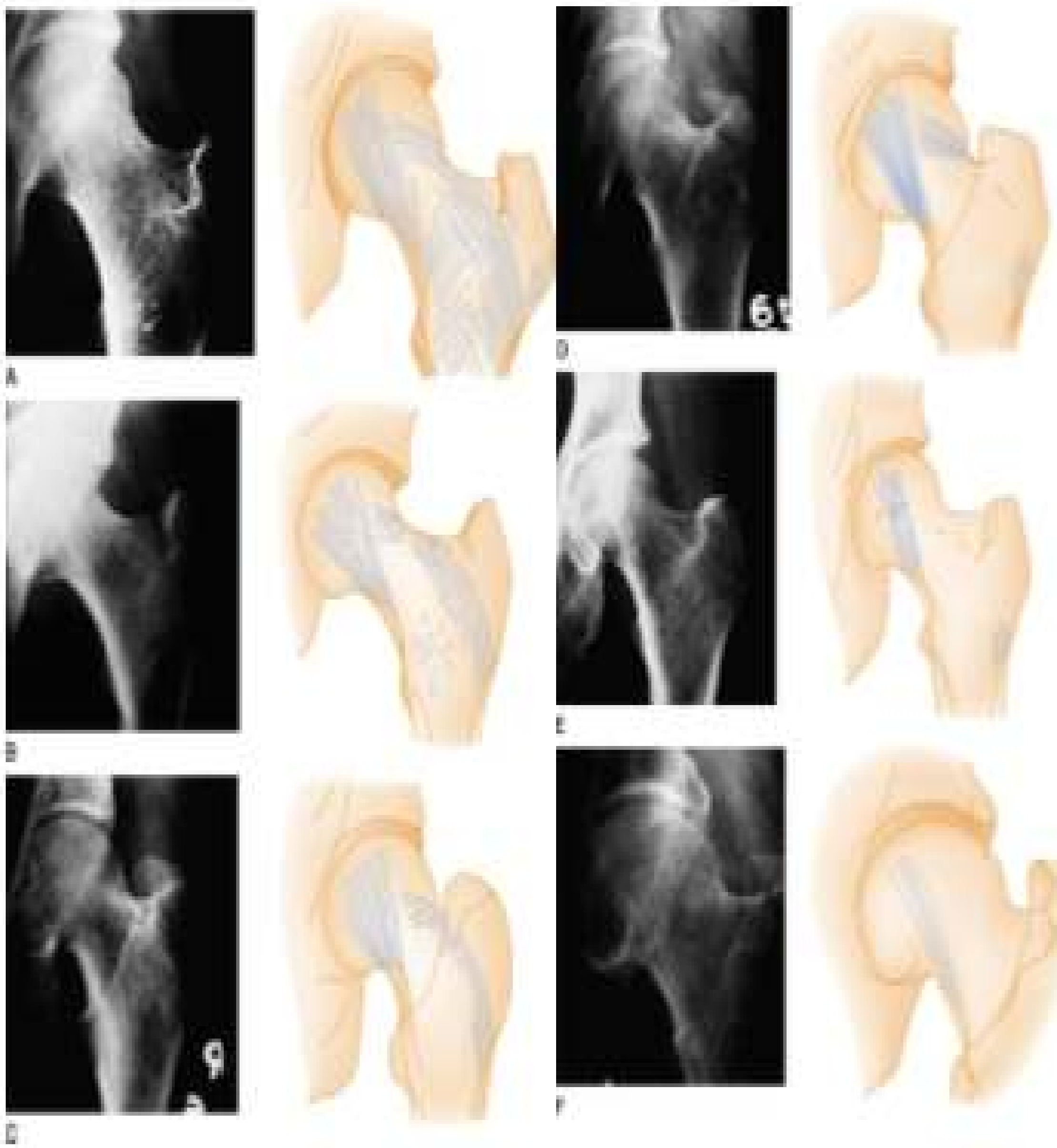
2. Principle tensile trabeculae: These extend from the interior region of the foveal area across the head to the lateral femoral cortex. These are produced as a result of shearing forces to which the upper end of femur is subjected. Only a small portion of the body weight is transmitted along these trabeculae.

In addition, there are secondary trabecular systems in the trochanteric region, they are:

3. Secondary compressive group: These extend from the medial femoral cortex to the greater trochanter.

4. Secondary tensile group: These extend from the lateral femoral cortex into the middle of the neck.





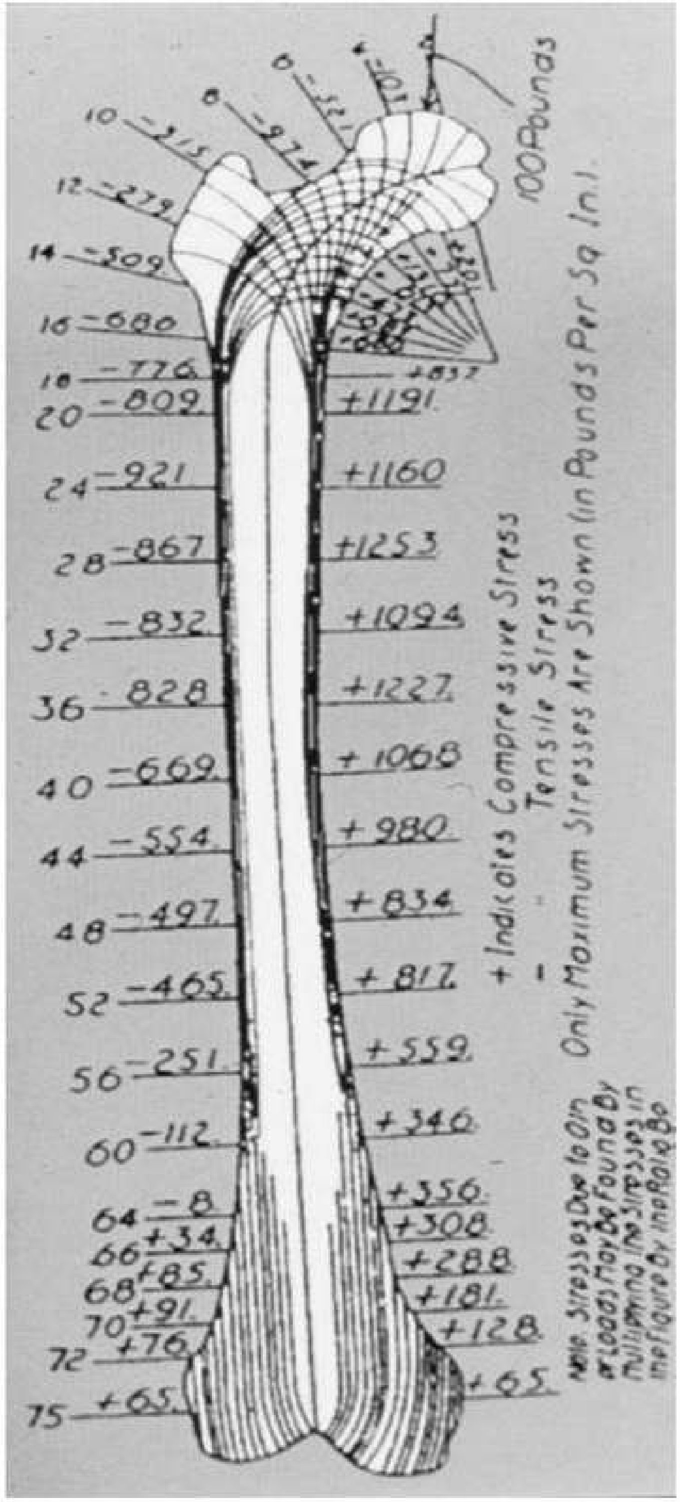
Singh’s index

Sub trochanteric region is between lesser trochanter and a point 5cm distal to lesser trochanter.Sub trochanteric segment is subject to high bio-mechanical stress.The medial and postero medial cortices are sites of high compressive forces,where as lateral cortex experiences tensile forces.

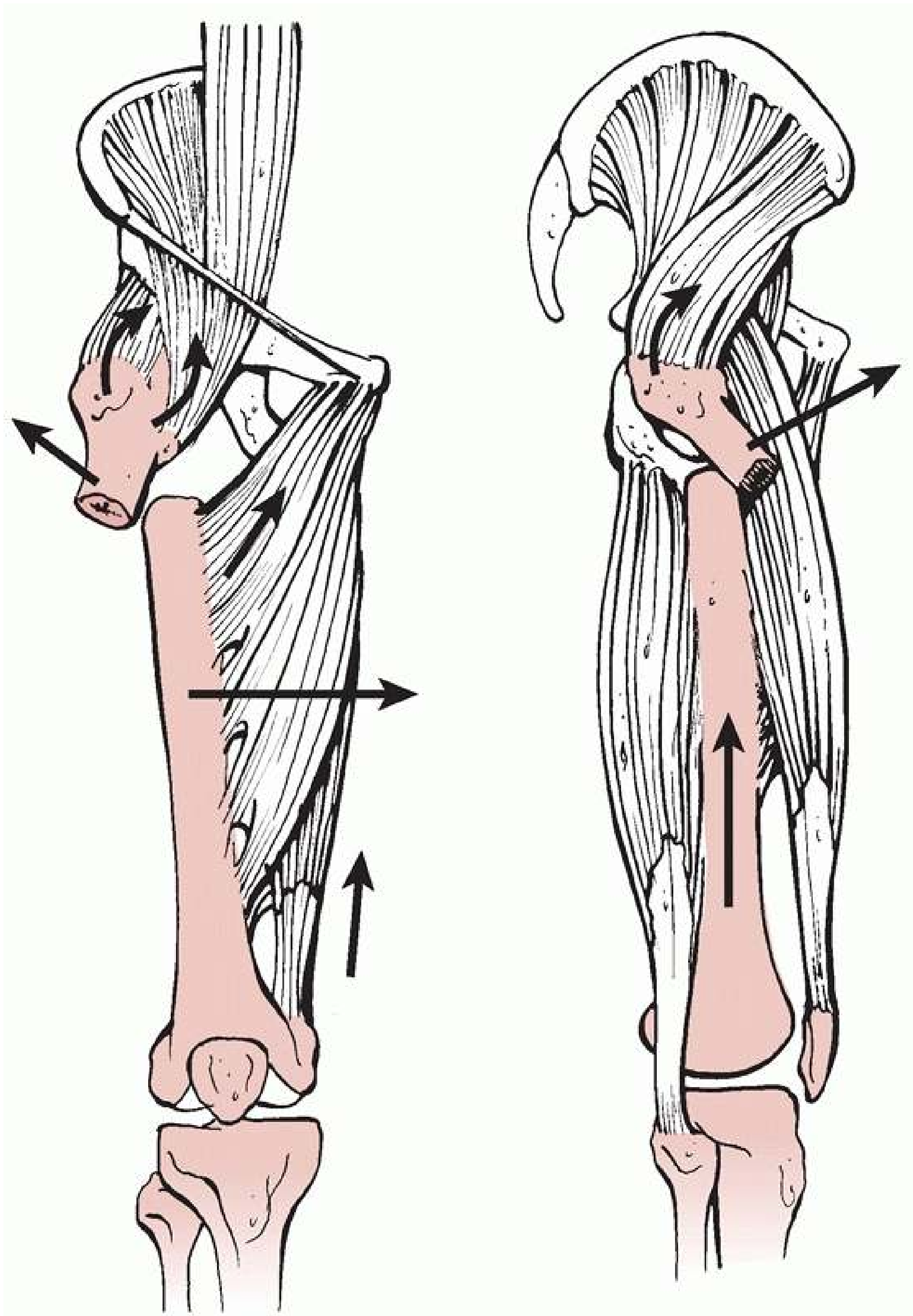
The subtrochanteric region is an area of high stress concentration. The proximal end of the femur has been likened to a cantilevered arch that transfers the force of weight bearing from the lower extremity to the hip and pelvis.

The sub trochanteric region is mainly composed of cortical bone[35].Therefore ,there is less vascularity in this region,and the potential for healing is diminished.

The deforming muscle forces on proximal fragment include abduction by gluteus, external rotation by short external rotators, flexion by psoas. The distal fragment is pulled proximally and into varus by adductors



Compressive and Tensile stress forces



DEFORMING MUSCLE FORCES

MOVEMENTS

Flexion	120°to130°
Extension	10° to 20°
Abduction	40°to 50°
Adduction	30°to 40°
Medial rotation	30°to 40°
Lateral rotation	40°to 50°

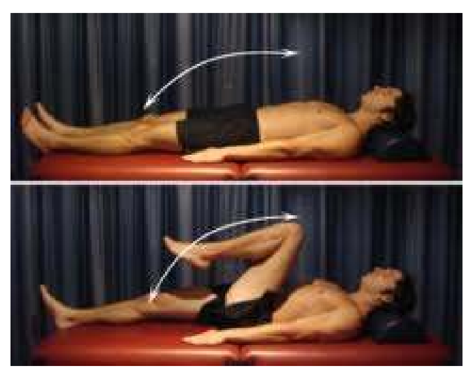
MOVEMENTS OF HIP :

ABDUCTION

ADDUCTION

INTERNAL ROTATION

EXTERNAL ROTATION



CLASSIFICATION OF TROCHANTERIC FRACTURES:

1. Boyd & Griffin classification
2. Evan's classification.
3. Orthopaedic trauma association (OTA) classification.
4. Seinsheimers classification
5. Russell and Taylor classification
6. Fielding classification

BOYD AND GRIFFIN

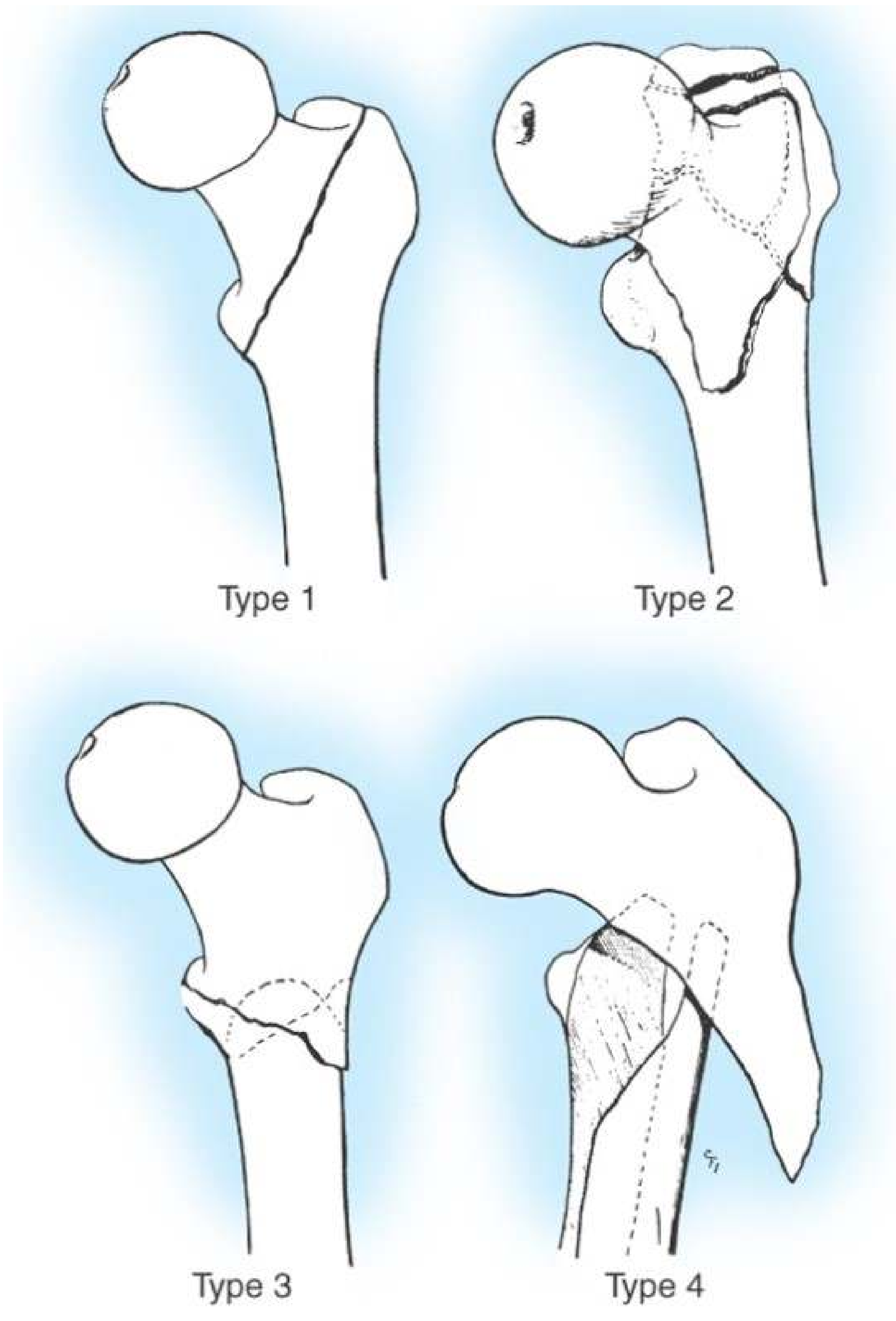
In 1949 Boyd and Griffin[7] described the first treatment recommendation classification, predictive of the difficulty of achieving, securing, and maintaining the reduction in four fracture types:

(i) Stable (two part);

(ii) unstable with posteromedial comminution;

(iii) subtrochanteric extension into lateral shaft extension of the fracture distally at or just below the lesser trochanter (the term reverse obliquity was coined by Wright);[220] and

(iv) subtrochanteric with intertrochanteric extension with the fracture lying in at least two planes



BOYD AND GRIFFIN CLASSIFICATION

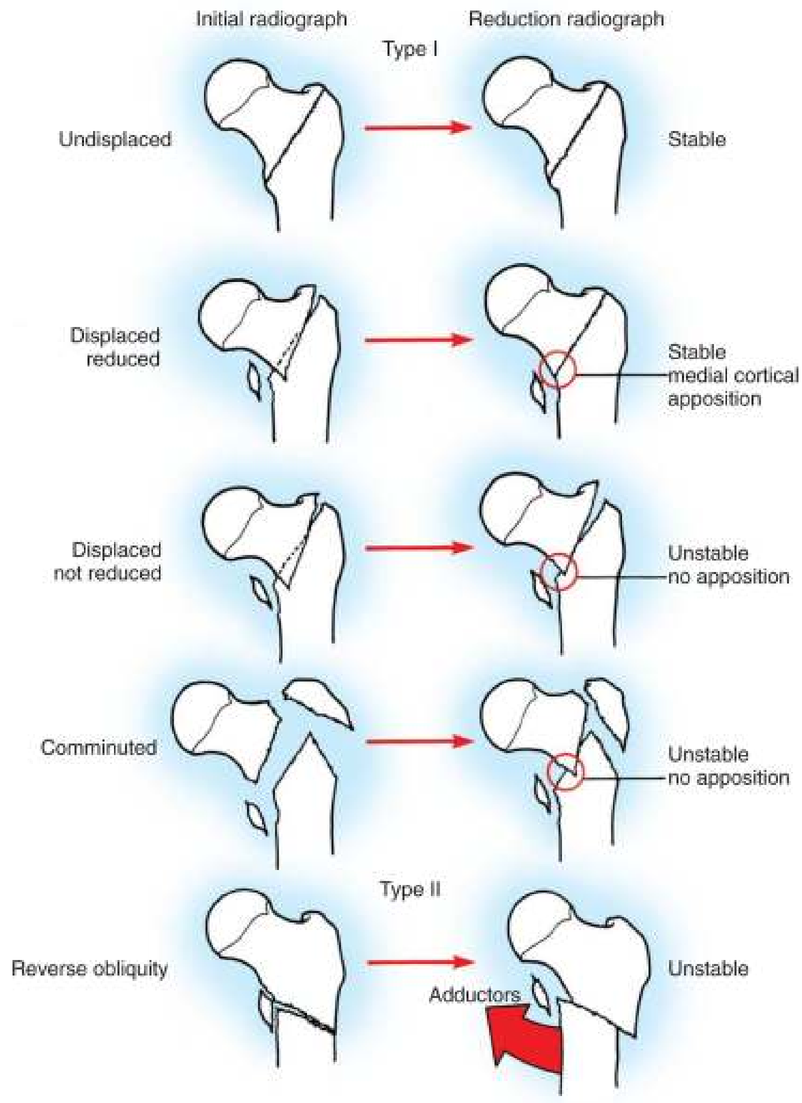
EVAN'S CLASSIFICATION:-

This classification system based on stability of fracture pattern. Evan[8] observed that the key to a stable reduction is restoration of posteromedial cortical continuity.

Type I: The fracture line extends upwards & outwards from the lesser trochanter.

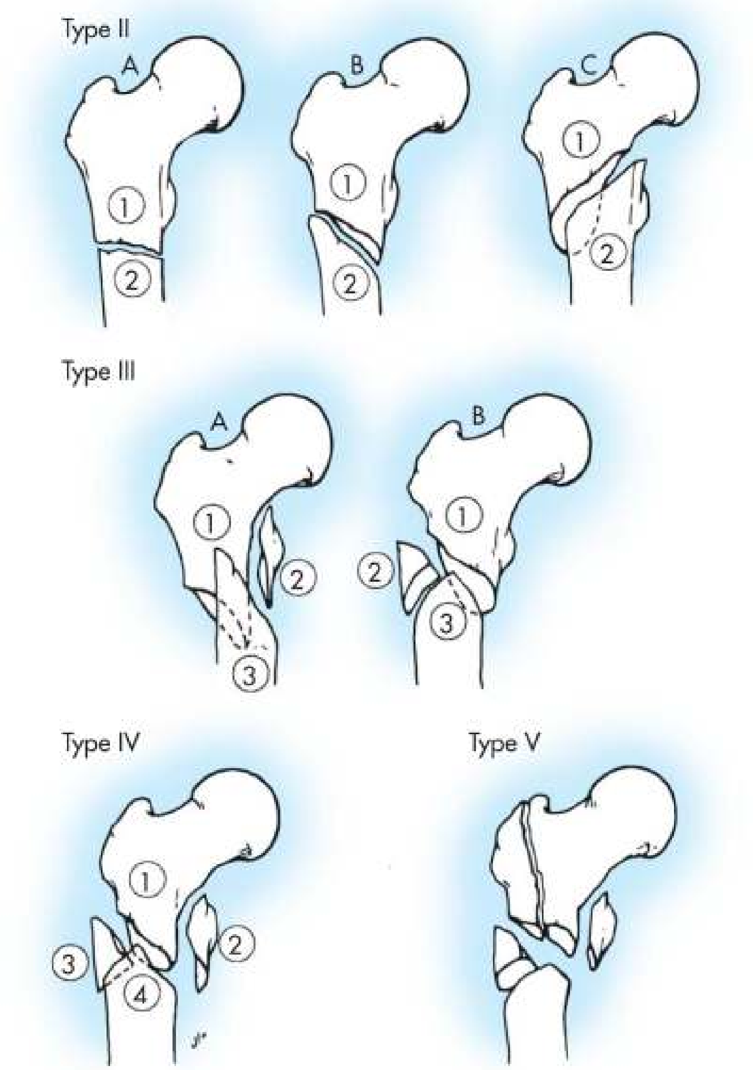
Type II: Reverse oblique fracture patternThe fracture line extends outward & downward from trochanter and is unstable.

EVANS CLASSIFICATION



Seinsheimer's classification[36]

Type I:	Nondisplaced fracture or any fracture with <2 mm of displacement of the fracture fragments, regardless of pattern
Type II:	Two-part fractures
IIA:	Two-part transverse femoral fracture
IIB:	Two-part spiral fracture with the lesser trochanter attached to the proximal fragment
IIC:	Two-part spiral fracture with the lesser trochanter attached to the distal fragment (reverse obliquity pattern)
Type III:	Three-part fractures
IIIA:	Three-part spiral fracture in which the lesser trochanter is part of the third fragment, which has an inferior spike of cortex of varying length
IIIB:	Three-part spiral fracture of the proximal third of the femur, with the third part a butterfly fragment
Type IV:	Comminuted fracture with four or more fragments
Type V:	Subtrochanteric-intertrochanteric fracture, including any subtrochanteric fracture with extension through the greater trochanter



Seinsheimers classification

RUSSEL TAYLOR CLASSIFICATION[37]

Type I: Fractures with an intact piriformis fossa in which:

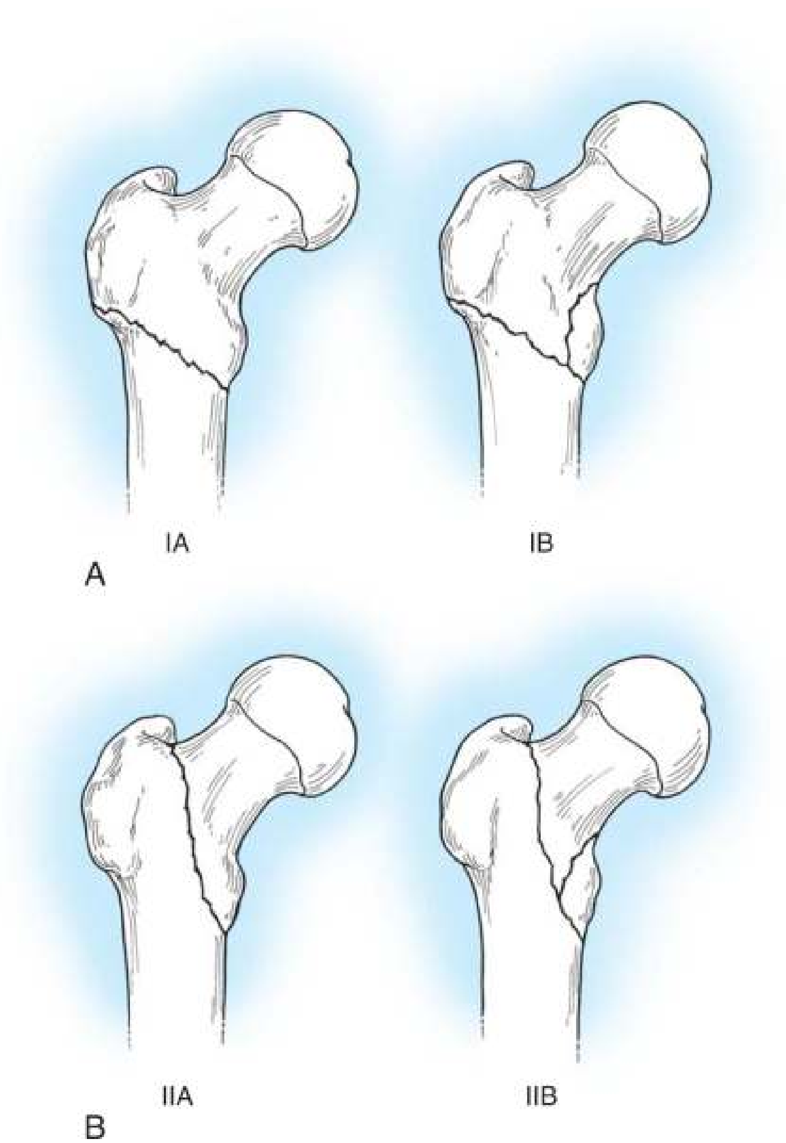
IA: The lesser trochanter is attached to the proximal fragment.

IB: The lesser trochanter is detached from the proximal fragment.

Type II: Fractures that extend into the piriformis fossa and:

IIA: Have a stable medial construct (posteromedial cortex).

IIB: Have comminution of the piriformis fossa and lesser trochanter, associated with varying degrees of femoral shaft comminution.



Russell and Taylor classification

OTA ALPHANEUMERIC FRACTURE CLASSIFICATION:

31 A:- Proximal femur trochanteric fractures.

A1: Pertrochanteric simple

A1.1: Along intertrochanteric line

A1.2: Through greater trochanter

A1.3: Below lesser trochanter.

A2: Pertrochanteric multi fragmentary

A2.1: With one intermediate fragment

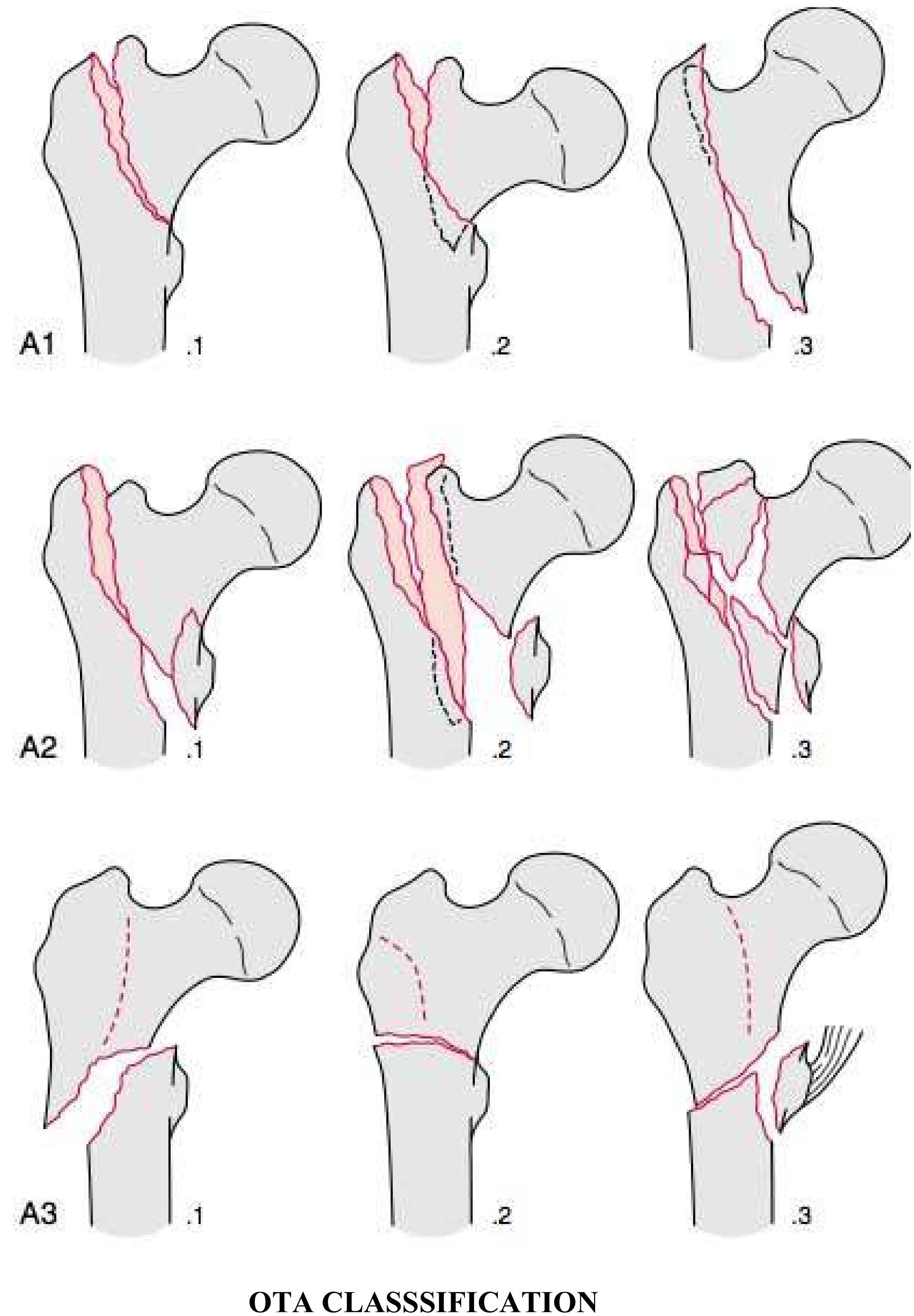
A2.2: With several intermediate fragments

A2.3: Extending more than 1cm below lesser trochanter.

A3: Fracture line extending into lateral cortex (reverse oblique fracture) A3.1: Simple oblique

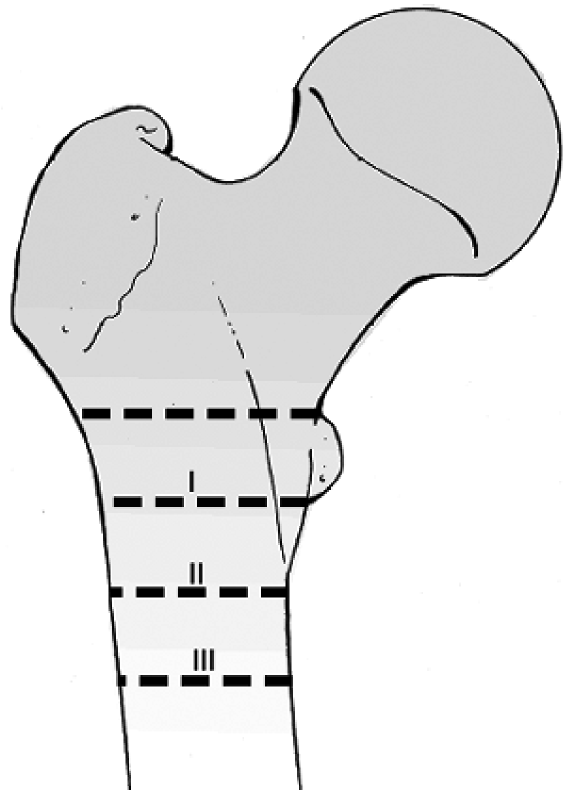
A3.2: Simple transverse

A3.3: Multi fragmentary.



OTA CLASSSIFICATION

FIELDING CLASSIFICATION[38]



Type I: At the level of the lesser trochanter

Type II: <2.5 cm below the lesser trochanter

Type III: 2.5 to 5 cm below the lesser trochanter

FRACTURE GEOMETRY AND INSTABILITY :

The fracture stability is largely dependent on the geometry of the fracture. The most commonly encountered patterns of instability are:

• Lesser trochanter communition

• Reverse oblique fracture

• Intertrochanteric fracture with sub- trochanteric extension.

A truly stable Intertrochanteric fracture[39] is one that when reduced has cortical contact without a gap posteriorly and medially. This contact will prevent further displacement into varus and retroversion. In the stable fracture the posterior & medial cortices are not comminuted and there is no displaced fracture of the lesser trochanter.

The importance of the lesser trochanter is the key to evaluating the stability of the fracture. The size & amount of displacement of this fragment are the critical factors in this evaluation. Up to 60% of intertrochanteric fracture are unstable & hence at a risk of complications.

The Lateral Wall

The lateral wall[40] of the trochanteric region has been given little importance in the past. Now it is believed that extensive communition of the lateral wall requires to be repaired thus the development of the trochanteric plate to buttress the lateral wall.

Reverse Oblique Fracture

In this type of fracture the fracture line extends from lesser trochanter infenorly to the lateral cortex The geometry of the fracture is such that it is inherently unstable. If this fracture is missed & treated with a sliding hip screw with plate it results in medialization of the distal fragment .Such fractures are best treated with a 95 blade plate or an intra medullary hip screw.

Intertrochanteric Fracture with Sub-Trochanteric Extension

These are highly unstable injuries. The marked comminution of the posteriomedial buttress combined with distal extension of the fracture renders them unstable. The distal extension of this fracture often makes plating difficult & an intramedullary nail is the better option.

MANAGEMENT OF TROCHANTERIC FRACTURES :

Trochanteric fractures can be managed in two ways,

1. Conservative or non operative method.

2. Operative method.

CONSERVATIVE MANAGEMENT

The indications for non operative treatment of intertrochanteric fractures are:

- An elderly person with high medical risk for anaesthesia and surgery.
- Non ambulatory patient with minimal discomfort following fractures.

SURGICAL MANAGEMENT:

Rigid internal fixation of intertrochanteric fractures with early mobilisation of the patients should be considered standard treatment.

The goals of operative treatment are;

- Rigid and stable fixation of the fracture fragments
- Early mobilization of the patient
- Restoration of the patient to his or her preoperative status at the earliest.

- Stability of fracture fixation depends on:
  - Bone quality.
  - Fracture pattern.
  - Fracture reduction.
  - Implant design.
  - Implant placement

VARIOUS IMPLANTS USED :

EXTRA MEDULLARY DEVICES

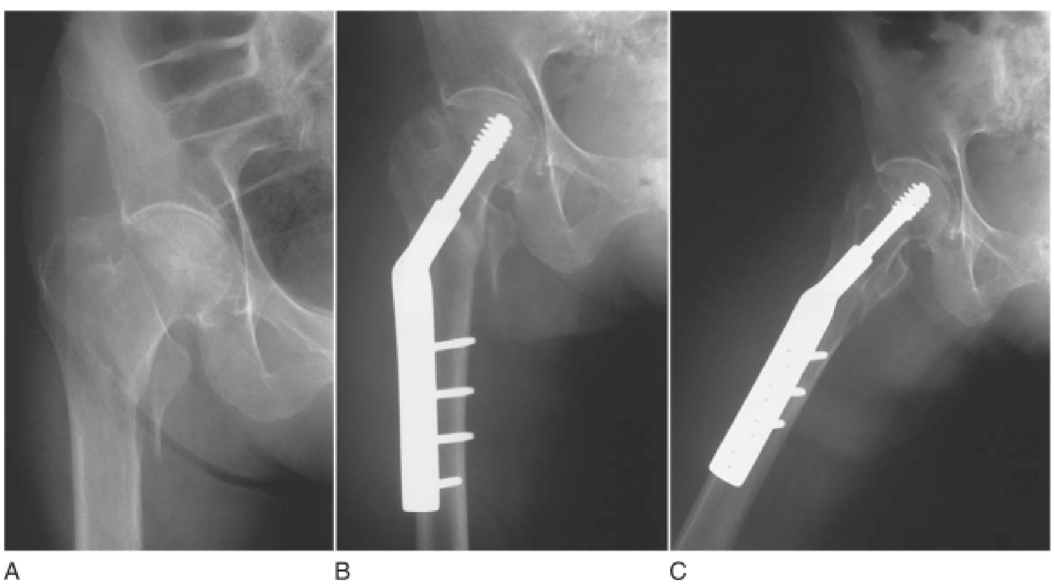
- Sliding hip screw - DHS
- 95 degree fixed angle plate
- Dynamic condylar screw - DCS
- Medoff plate
- Trochanteric locking plate

INTRA MEDULLARY DEVICES

- Gamma Nail
- Proximal Femur Nail

Sliding hip screw:

Internal fixation with dynamic hip screw[41] is the treatment of choice for stable intertrochanteric fracture. However the scenario is different when comes to the management of unstable fracture. Failure rate of as high as 56% have been noted with internal fixation of unstable fractures. to excessive collapse at the fracture site with migration of femoral head into varus and retroversion , which results in shortening and decreased abductor lever arm causing limping of the patient . Another complication is screw cut out from femoral head.

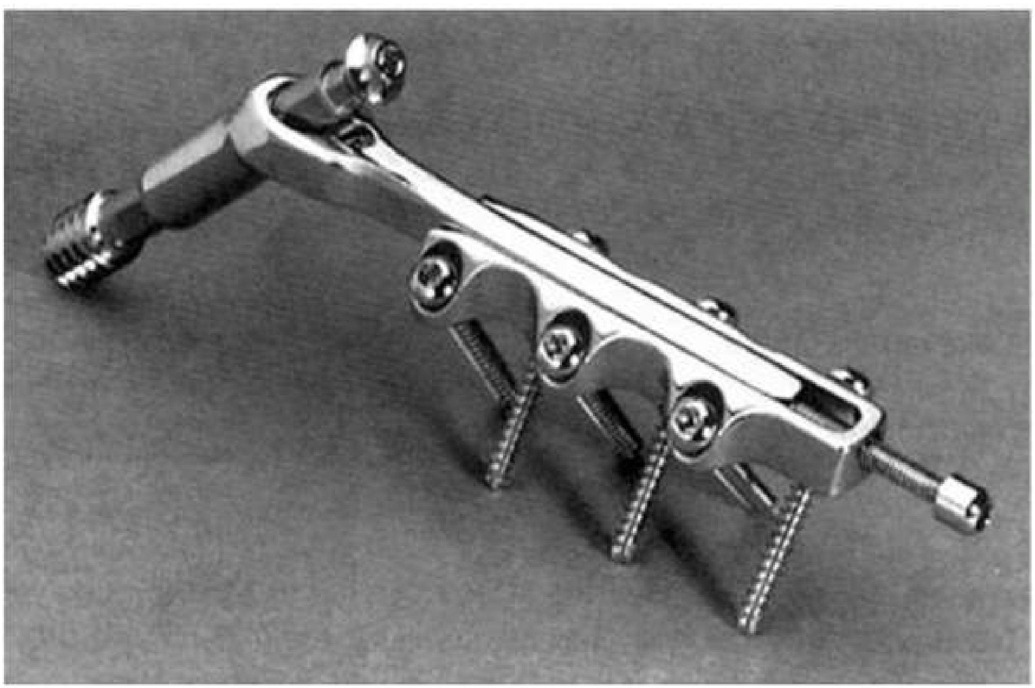


95 degree fixed angle plate and dynamic condylar screw:[42]

When internal fixation of subtrochanteric fractures was first promoted by this group the technique aimed at anatomic reduction and stable fixation of all fragments. Primary bone healing was found to be possible if fracture gaps were closed and if rigid stabilization was achieved. However, in comminuted fractures for which extensive soft-tissue dissection was necessary to achieve anatomic reduction, the incidence of delayed union, nonunion, infection, and implant failure was significant.

Medoff sliding plate:

The Medoff sliding plate[14] design uses a biaxial sliding hip screw. It has a standard lag screw/barrel component for compression along the femoral neck. In place of the standard femoral side plate, it uses a coupled pair of sliding components that enable the fracture to impact parallel to the longitudinal axis of the femur. A locking set-screw may be used to prevent independent sliding of the lag screw within the plate barrel; if the locking set screw is applied, the plate can only slide axially on the femoral shaft (uniaxial dynamization). If the surgeon applies the implant without placement of the locking set screw, sliding may occur along both the femoral neck and femoral shaft (biaxial dynamization). For most of unstable intertrochanteric fractures, biaxial dynamization is suggested.



Intramedullary hip screw :

The favorable experience with interlocked nailing for comminuted subtrochanteric fractures gave the surgeon the opportunity to treat difficult fractures with much less soft-tissue dissection. It showed conclusively that anatomic alignment rather than anatomic reduction combined with stable fixation results in a high percentage of favorable fracture outcomes.

Increased failure rates with use of a sliding hip screw in unstable fracture patterns led to the development of intra- medullary nails[44] designed specifically for stabilization of peritrochanteric fractures. These nails offer several potential advantages:

1) An intramedullary nail, can share more load compared to other plate and screw designs as it is centrally located within the medullary canal.

2) Implant failure has been greatly reduced since there is reduced tensile forces with the shorter lever arm.

3) Intramedullary devices are always superior as they require a smaller skin incision,reduced blood loss and early mobilization .

4) The intramedullary location limits the amount of sliding and, therefore, limb shortening and deformity that can occur compared with the sliding hip screw—the fracture can settle only until the proximal fragment abuts against the nail.

Use of a long intramedullary nail protects against subsequent fracture in the same femur.

These implants can be inserted in a closed manner with limited fracture exposure, decreased blood loss, and minimal tissue damage than an SHS. It limits the amount of fracture collapse, compared with SHS.

This implant is most effective in intertrochanteric fractures with subtrochanteric extension and in reverse obliquity fractures. Use of this implant in unstable trochanteric fractures management has been encouraging.

Many types of intramedullary devices[45] can be used for stabilization of proximal femur fractures. All have similar basic characteristics:

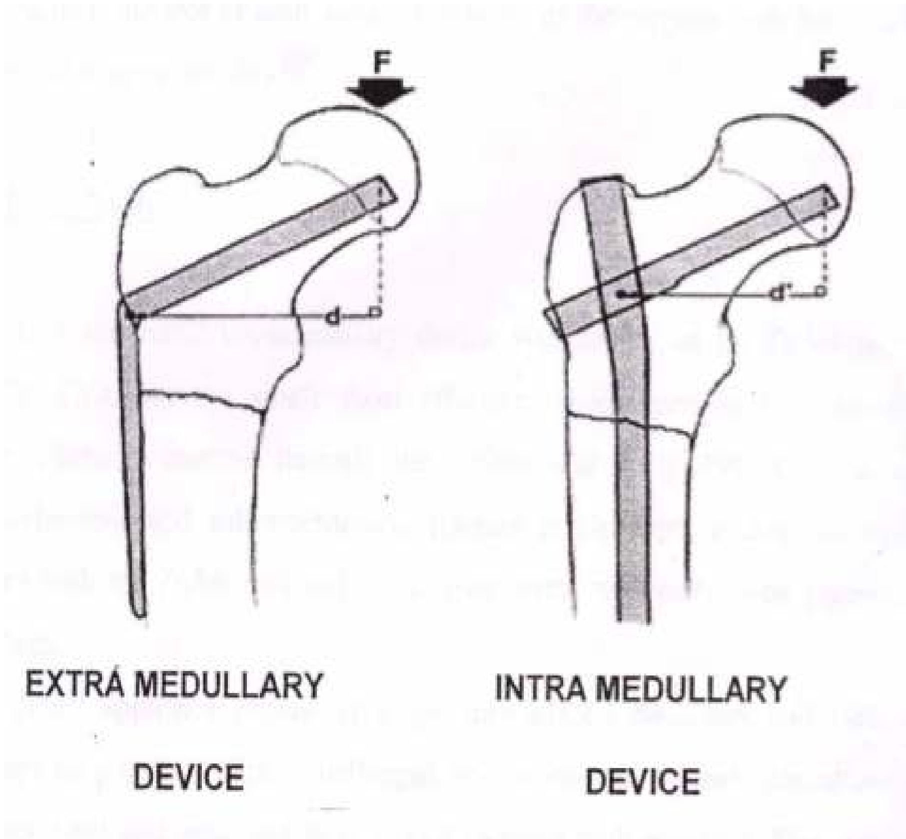
1) They are designed for insertion through the greater trochanter, requiring a valgus offset of proximal nail.

2) The proximal aspect of nail must be sufficiently wide to allow large diameter lag screw passage.

3) They can be placed through a small incision.

4) They can be both statically and dynamically locked.

5) They limit the amount of screw sliding and subsequent proximal deformity of the proximal femur



BENDING-MOMENTUM ON EXTRA AND INTRAMEDULLARY IMPLANT

PROXIMAL FEMUR NAIL:

The implant consists of a proximal femoral nail[32], self tapping 6.4mm derotation hip pin, self tapping 8 mm femoral neck lag screw, 4.9mm distal locking screws, and an end cap. Proximal femoral nail is made up of either 316L stainless steel or titanium alloy which comes in following sizes.

1) Length: standard PFN –250 mm

Long PFN- 340,360,380,400 and 420mm.

2) Diameter: 9,10,11,12 mm

3) Neck shaft angle range: 125, 130,135.

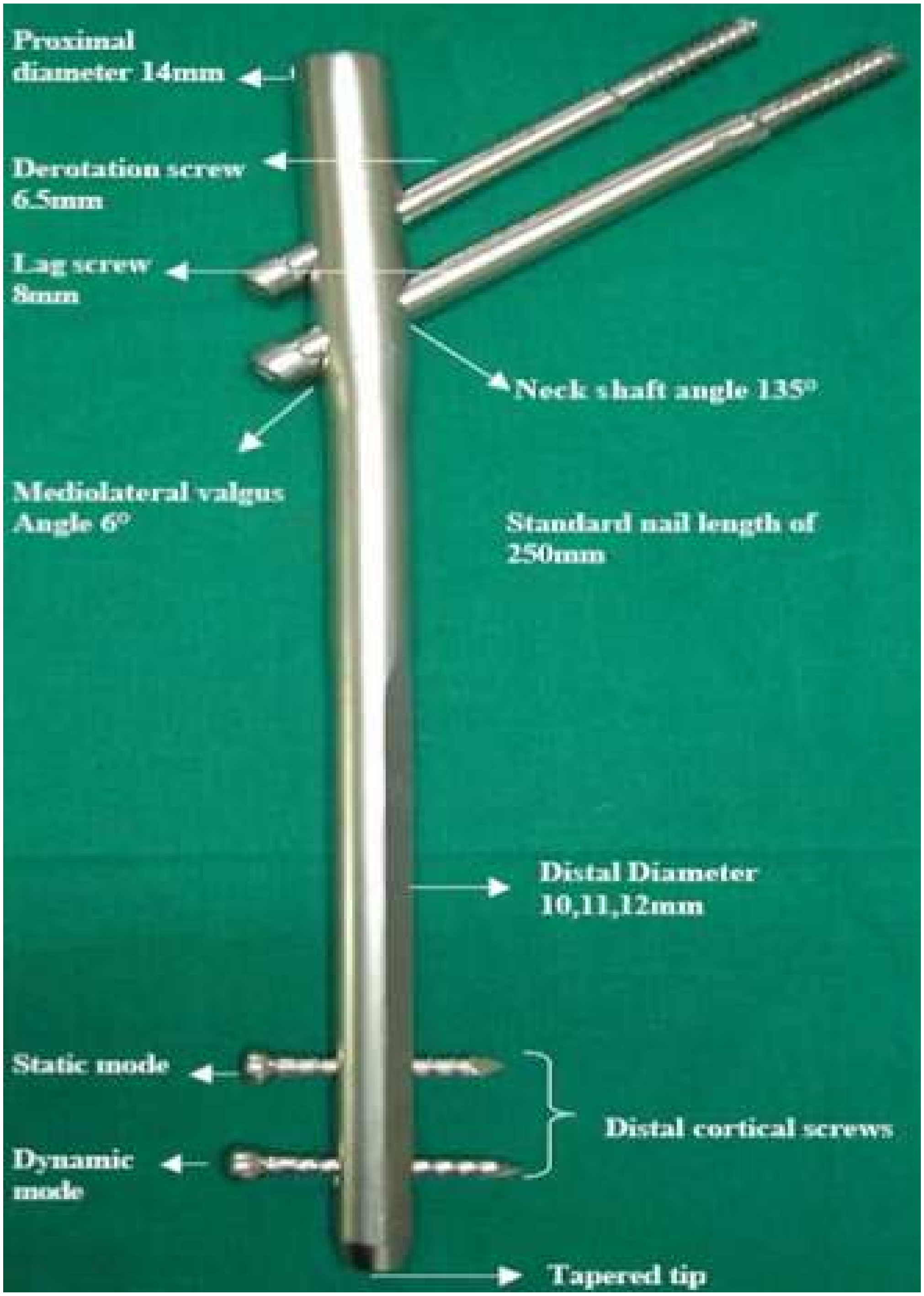
The nail is having 14mm proximal diameter. This increases the stability of the implant. There is 6 mediolateral valgus angle, which prevent varus collapse of the fracture even when there is medial comminution.

The fluting tip[46] of the nail prevent stress concentration at the end of the nail and avoids fracture of the shaft distal to the nail.

Proximally it has 2 holes: the distal one is for the insertion of 8 mm lag screw which acts as a sliding screw, The 8mm lag screw was inserted close to the sub chondral bone –optimal position was inferior to centre of femoral head in AP view and in centre in lateral view. 8mm lag screw was designed to carry most of the load .The proximal one is for 6.4 mm hip pin which helps to prevent the rotation.

Distally nail has two holes for insertion of 4.9 mm locking screws, of which one is static and the other one is dynamic which allows dynamization of 5 mm.

PROXIMAL FEMUR NAIL



Z-EFFECT:[47]

If the hip pin is longer than the lag screw, vertical forces would increase on the hip pin and start to induce cut- out, a knife effect or Z-effect. This might force the hip pin to migrate into the joint and the lag screw to slide laterally.

MATERIALS AND METHODS

This is a prospective,non randomised control study conducted in Coimbatore Medical College & Hospital. Patients with unstable Inter trochanteric and subtrochanteric fractures who met our **INCLUSION CRITERIA** were selected

1. Patients sustaining sub trochanteric fractures and unstable inter trochanteric fractures – reverse oblique fractures

2. Patients who were independently mobile before sustaining injury.

3. Both men and women above 18 years

EXCLUSION CRITERIA

1.Patients with pathological fractures.

2.Patients who were terminally ill,with severe life threatening diseases,who were not fit for surgery

3.Paediatric patients

4.Open fractures

METHODS:

PREOPERATIVE EVALUATION:

After patient's admission detailed history regarding mode of injury, associated co-morbid condition was taken. Clinical assessment of the patients were done in detail. All patients were treated preoperatively with upper tibial traction, with the aim of relieving pain, preventing shortening and to reduce unnecessary movement of injured limb. Oral or parental NSAIDs were given to relieve the pain.

The following investigations were done routinely on all these patients preoperatively.

Blood investigations includes Haemoglobin %, blood grouping and Cross matching, fasting and Post prandial blood sugar, blood urea and Serum creatinine.

Radiograph :

- Pelvis with both hips – AP
- Injured Hip with femur-AP (Traction and internal rotation view)
- Chest X ray PA view

Pre-op planning

- Determination of nail diameter: Nail diameter was determined by measuring diameter of the femur at the level of isthmus on an AP x ray.
- Determination of neck shaft angle: Neck shaft angle was measured on the unaffected side on an AP x-ray using goniometer.

Preoperative preparation:

Injection Xylocaine 0.5cc Intradermally and injection TT 0.5cc Intramuscularly given the day prior to surgery. Intravenous antibiotic were given an hour before the surgery.

The back, lateral aspect of the hip from the iliac crest to the distal thigh, groin was prepared.

OPERATIVE TECHNIQUE

Patient positioning and fracture reduction:

The patient was placed in supine position on fracture table with adduction of the affected limb by 10 to 15 degree and closed reduction of the fracture was done by traction and gentle rotation. The unaffected leg was flexed and abducted as far as possible in order to accommodate to image intensifier. The image intensifier was positioned so that anteroposterior & lateral views of the hip and femur could be taken.

Closed reduction under image intensifier:

Then the regular 7.5 % povidone iodine scrubbing is done for the affected side followed by draping with sterile sheets.

Approach :

The tip of the greater trochanter was located by palpation in thin patients and in hefty patients we used image intensifier and 5 cms longitudinal incision taken proximal from the tip of the greater trochanter[46]. A parallel incision was made in the fascia lata and gluteus medius was split in line with the fibres. Tip of the greater trochanter is exposed.

Determination of the entry point and insertion of guide wire:

In AP view on C-arm, the entry point is on the tip or slightly lateral to the tip of the greater trochanter. In lateral view, guide wire position confirmed in the center of the medullary cavity. The guide wire is inserted in this direction along the medullary canal .

Opening of the femur:

Over the guide wire a cannulated rigid reamer is inserted through the protection sleeve and manual reaming was done as far as the stop on the protection sleeve.

Insertion of the PFN:

After confirming satisfactory fracture reduction an appropriate size nail as determined pre operatively was assembled to the insertion handle and inserted manually as far as possible into the medullary cavity.The nail is inserted slowly inside the canal until the hole for the 8mm lag screw is at the level inferior aspect of the neck.In cases where satisfactory reduction was not possible by closed means, open reduction was done.

Insertion of the guide wire for neck screw and hip pin :

Inner and outer drill sleeves are fixed to the jig so that the outer sleeve is hitching the lateral cortex. A 2.5 mm guide wire was inserted through the drill sleeve after a stab incision with its position in the caudal area of the femoral head for neck screw. This guide wire is inserted 5 mm deeper than the planned screw size. The final position of this guidewire should be in the lower half of the neck in AP view and in the center of the neck in lateral view. Proper positioning of the nail will aid in proper anteversion of the neck screw as there is inbuilt anteversion in the hole on the nail. A second 2.5 mm guide wire is inserted through the drill sleeve above the first one for hip pin. The tip of this guide wire should be 5mm deeper than the planned hip pin but approximately 25-20 mm less deep than planned neck screw.

Insertion of the neck screw:

A measuring device is inserted over the 2.5 mm guide wire until it touches the bone. The correct length is indicated on the measuring device and calculated to end approximately 5 mm before the tip of the guide wire. This length is set on the 8 mm reamer by securing the fixation sleeve in correct position. Drilling is done over 2.5 mm guide wire till the fixation sleeve prevents further drilling. Tapping is not done as the neck screw is self tapping. Neck screw is inserted using cannulated screw driver. Final position confirmed with image intensifier.

Insertion of the antirotation screw :

The hip pin is inserted first to prevent the possible rotation of the medial fragment when inserting the neck screw. The length of the hip pin is indicated on measuring device and is calculated 5 mm before the tip of the guide wire. Drilling is done over the guide wire with 6.4 mm drill bit to a depth up to the length of hip pin previously measured. The same length 6.4 mm hip pin is inserted with the help of hexagonal cannulated screwdriver. Length and position to be confirmed with C-Arm.Guide wire is then removed.

Distal locking :

Distal locking is usually performed with two 4.9mm locking bolts. For standard PFN, aiming was used. A drill sleeve system was inserted through a stab incision. A drill hole is made with 4 mm drill bit through both cortices length is measured directly from the drill marking. Locking screw is inserted through protection sleeve position confirmed with image intensifier.

Closure:

After the fixation is over, lavage is given using normal saline. Incision closed in layers. Sterile dressing is applied over the wounds and compression bandage given.

PFN INSTRUMENTATION

PFN NAIL

SHORT PFN

LONG PFN

PFN ASSEMBLING

SURGICAL STEPS:

Draping

Incision for entry point

Entry point

C-arm image of entry point

Insertion of guide wire

Reaming over guide wire

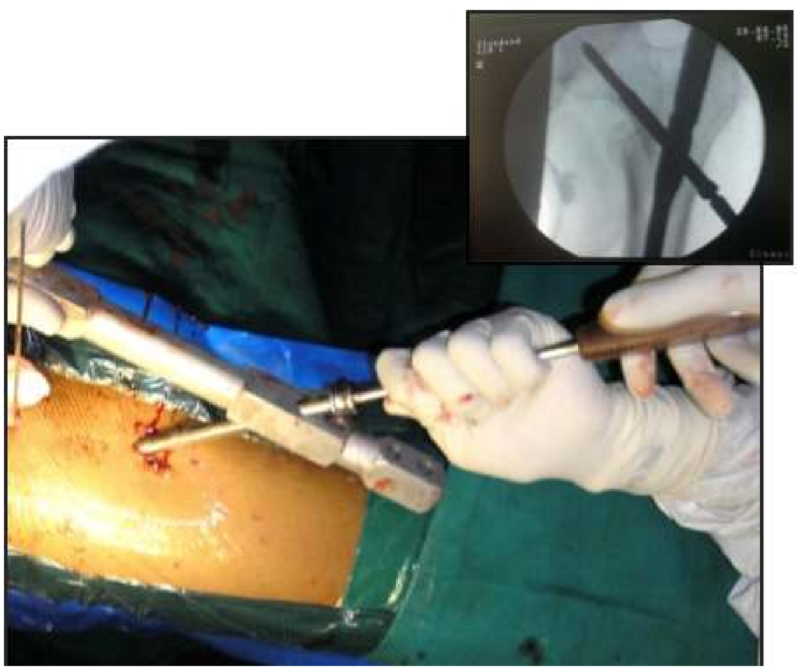
C-arm image

Insertion of nail over guide wire

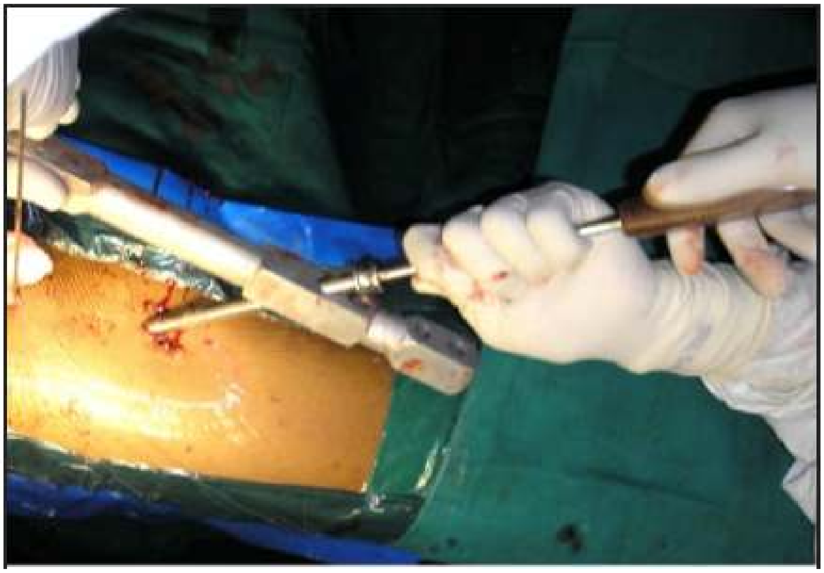
Insertion of guide wire for neck screw

Drilling over guide wire for neck screw

Insertion of neck screw

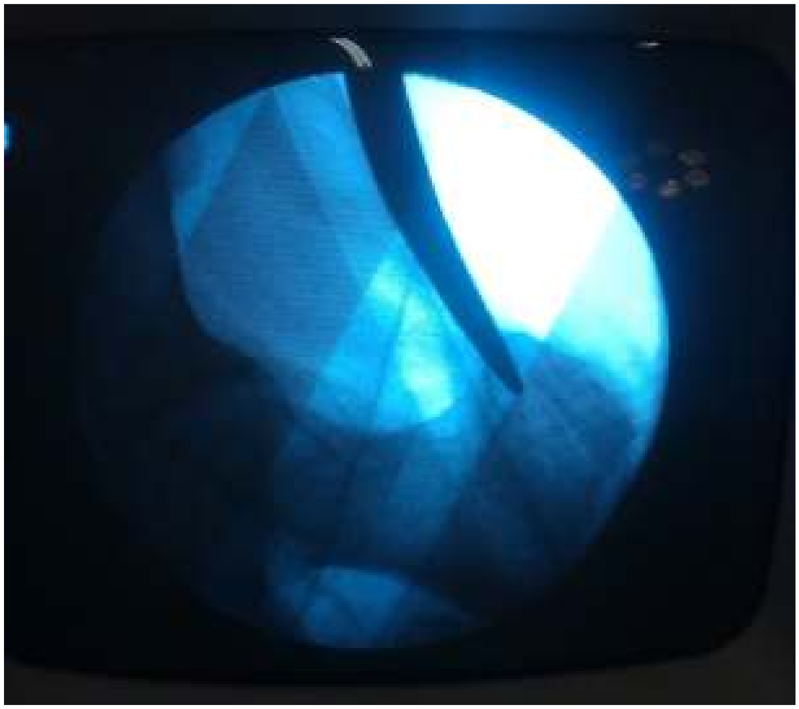


Insertion of anti rotation screw

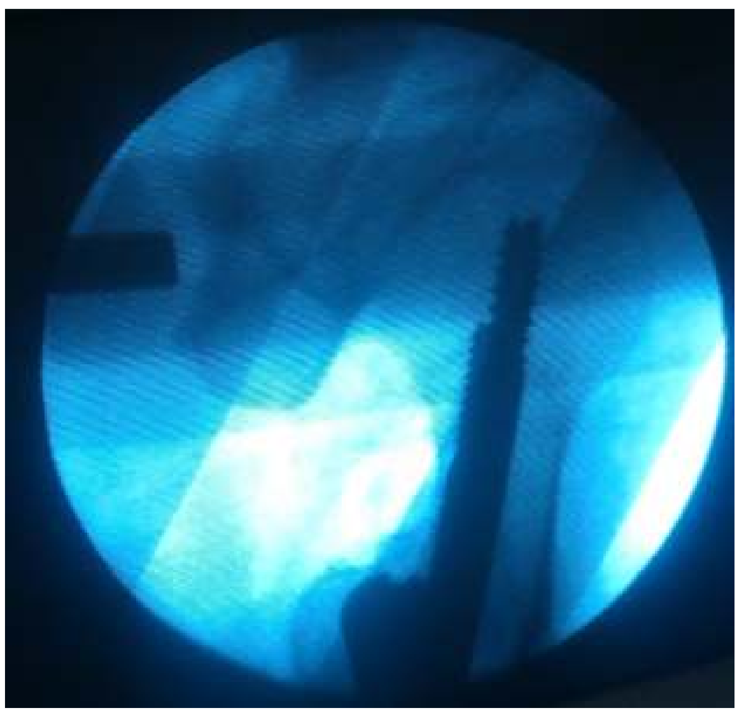


Distal locking

C ARM IMAGES




06



After treatment:

Post operatively vital signs of the patients were recorded.Joints (both hip and knee) were mobilized while the patient was under spinal anesthesia. Intravenous antibiotics were given for 2 days. Analgesics were given for pain management. Drain was removed after 48 hours. Hip and knee ROM exercises were taught and patients were encouraged to do so under the supervision of physiotherapist. DVT prophylaxsis were given in obese patients. Partial weight bearing with the aid of walker is begun on 5^{th} post operative day depending on fracture stability.

Follow up :

All patients were followed up at an interval of 6 weeks till the fracture union is noted and then after once in 3 months till 1year. At every visit patient was assessed clinically regarding hip and knee function, walking ability, fracture union, deformity and shortening. Harris Hip scoring system was used for evaluation.

X-ray of the involved hip with femur was done to assess fracture union and implant bone interaction.

Results of the surgery:

Functional Results Assessed based following hip scoring system adopted.

Harris Hip Scoring System: Maximum points possible - 100

Pain relief- 44

Function- 47

Absence of deformity- 4

Range of motion- 5

Harris hip score is a validated 15 item questionnaire in which scores range from0 to 100.

< 70 -Poor

70-79 - Fair

80-89 - Good

90-100 - Excellent.

BOX 3-2 Harris Hip Evaluation (Modified)

Pain
- ☐ None or ignores it (44)
- ☐ Slight, occasional, no compromise in activities (40)
- ☐ Mild pain, no effect on average activities, rarely moderate pain with unusual activity; may take aspirin (30)
- ☐ Moderate pain, tolerable but makes concessions to pain; some limitation of ordinary activity or work; may require occasional pain medicine stronger than aspirin (20)
- ☐ Marked pain, serious limitation of activities (10)
- ☐ Totally disabled, crippled, pain in bed, bedridden (0)

Limp
- ☐ None (11)
- ☐ Slight (8)
- ☐ Moderate (5)
- ☐ Severe (0)

Support
- ☐ None (11)
- ☐ Cane for long walks (7)
- ☐ Cane most of the time (5)
- ☐ One crutch (3)
- ☐ Two canes (2)
- ☐ Two crutches (0)
- ☐ Not able to walk (0)

Distance Walked
- ☐ Unlimited (11)
- ☐ Six blocks (8)
- ☐ Two or three blocks (5)
- ☐ Indoors only (2)
- ☐ Bed and chair (0)

Stairs
- ☐ Normally without using a railing (4)
- ☐ Normally using a railing (2)
- ☐ In any manner (1)
- ☐ Unable to do stairs (0)

Put on Shoes and Socks
☐ With ease (4) ☐ With difficulty (2) ☐ Unable (0)

Sitting
- ☐ Comfortably in ordinary chair 1 hour (5)
- ☐ On a high chair for $^1/_2$ hour (3)
- ☐ Unable to sit comfortably in any chair (0)

Enter public transportation: ☐ Yes (1) ☐ No

Flexion contracture: ________ (degrees)

Leg-length discrepancy: ________ (cm)

Absence of Deformity (all Yes = 4; <4 = 0)

<30 degrees fixed flexion contracture:	☐ Yes	☐ No
<10 degrees fixed adduction:	☐ Yes	☐ No
<10 degrees fixed internal rotation in extension:	☐ Yes	☐ No
Limb-length discrepancy <3.2 cm:	☐ Yes	☐ No

Range of Motion (*Normal)

Total degree measurements, then check range to obtain score

Flexion (*140 degrees): ________
External rotation (*40 degrees): ________
Abduction (*40 degrees): ________
Internal rotation (*40 degrees): ________
Adduction (*40 degrees): ________

Range-of-Motion Scale

211-300 degrees (5)	61-100 degrees (2)
161-210 degrees (4)	31-60 degrees (1)
101-160 degrees (3)	0-30 degrees (0)

Range-of-Motion Score: ________

Total Harris Hip Score: ________

Readmission to Hospital: ☐ Yes ☐ No
Date of Readmission: ___/___/___
Implant Removal Date: ___/___/___

Comments: ____

____

Investigator Signature: ______________________________ **Date:** ___/___/___ (mm/dd

RESULTS

The following observations were made from the data collected during this study of proximal femoral nail in the treatment of 20 cases of trochanteric and sub trochanteric fractures of proximal femur in the Department of Orthopaedic Surgery, Coimbatore Medical College and Hospital between Sep 2012 to May 2014.

Age and Sex Distribution

In our series, majority of the cases i.e.9 (45%) were in the age group of 20-40 years, followed by 8 (40%) cases in the age group 41-60 years. The youngest patient was 20 years old and eldest patient was 65 years. The mean age was 55.18 years.In our study we had 17 male patients and rest were female.

Nature of violence

9 cases (45%) affected were due to RTA, 5 cases (25%) due to slip and fall, and 5 cases (25%) due to Fall from height. RTA was the most common mode of injury.

Side Affected

Right side was involved in 12 (60%) cases and leftt in 8 (40%), Right side was more commonly involved than left side.

Type of fracture

In our study, majority of the cases 6 cases had type 2 , followed by 4 cases of type IIIA,4 cases of type IIIB and 3 cases of type IV Seinsheimers classification

The most common associated co morbid medical problem was systemic hypertension in 3 patients followed by type II diabetes mellitus in one patient, bronchial asthma in one patient.

Associated injuries:

2 patients had an associated acetabular fracture,one patient had calcaneal fracture,one had bladder injury.

The mean time from injury to surgery was 15 days.Spinal anesthesia was given in all the patients.Closed reduction was attempted in all cases under image intensifier.Open reduction was done in 6 cases.Nail was inserted only after obtaining anatomical reduction.Reduction was confirmed under image intensifier.

Implant details:

Long Proximal Femoral Nail was used in 6 cases whereas in rest of the cases short nail of size 25 mm was used.130 degree nail was used in

14 casess and 135 degree nail in 6 cases.Mean operating time was 75 min.Average blood loss was around 250 ml.

Post operatively hip ,knee and ankle joints were mobilized immediately.Partial weight bearing was started on an average of 7^{th} post operative day.Full weight bearing began only after radiological evidence of fracture union.Mean duration of fracture union was 16 weeks.

Complications :

Superficial infection was present in 2 cases,deep infection in one case. Significant shortening of 2 cm was seen in 6 cases.One patient died due to myocardial infarction. 4 patients complained of lateral thigh pain. There was no incidence of deep vein thrombosis, pneumonia, pressure sores or cardiovascular complication in the early post operative period.

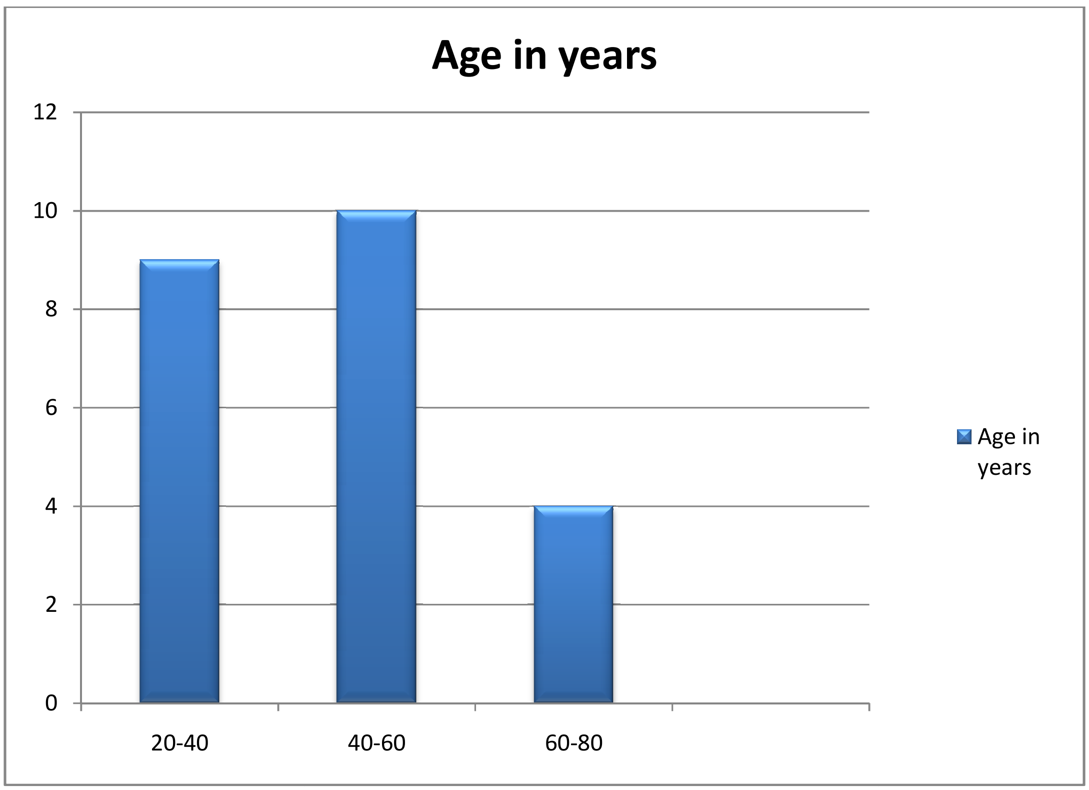
Functional outcome analysis:

The functional results were graded according to Harris Hip Scoring System. In our study, 5 patients had excellent results, 6 patients had good results, 5 patients had fair results, 4 cases had poor result.

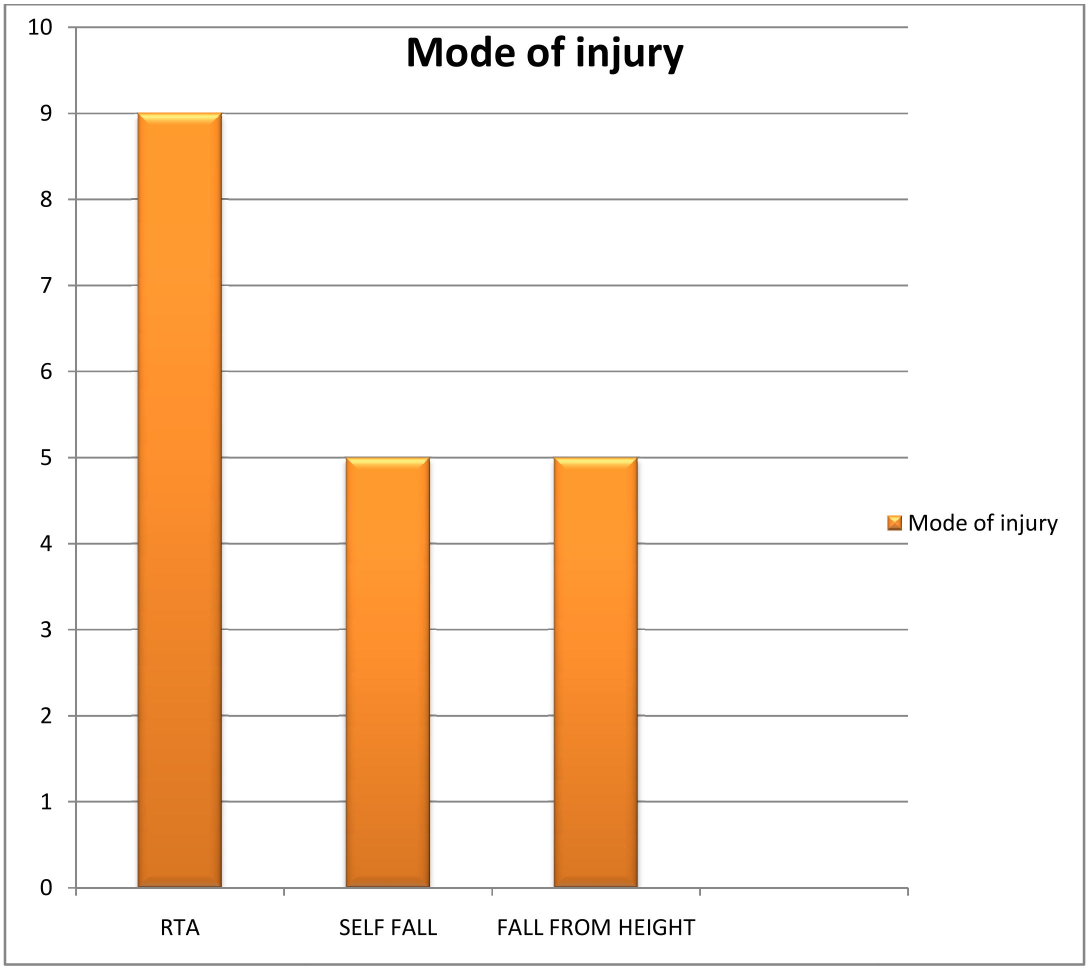
Radiological analysis:

Mean tip apex distance was 23mm.Fracture union was achieved after a mean period of 16 weeks. Varus malunion was seen in one patient. Z effect was seen in one patient.No screw or implant breakage was seen

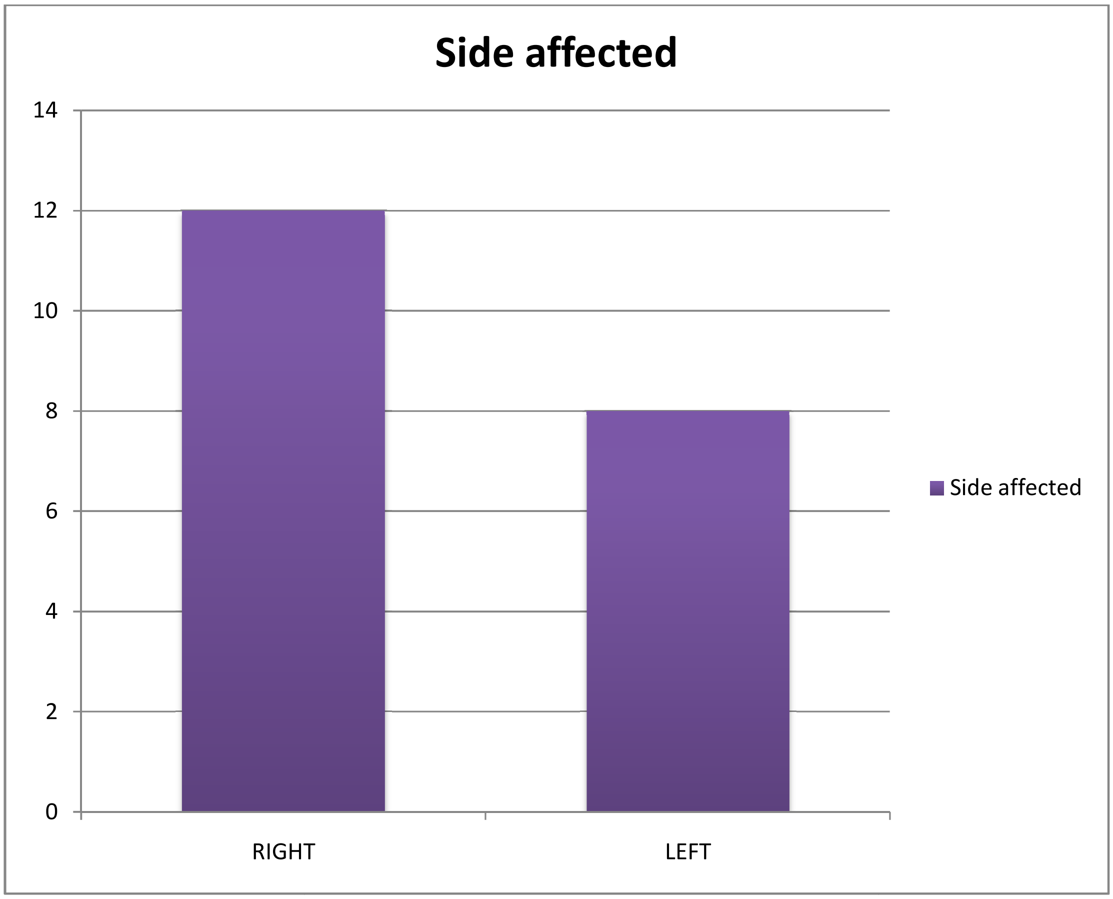
Age distribution



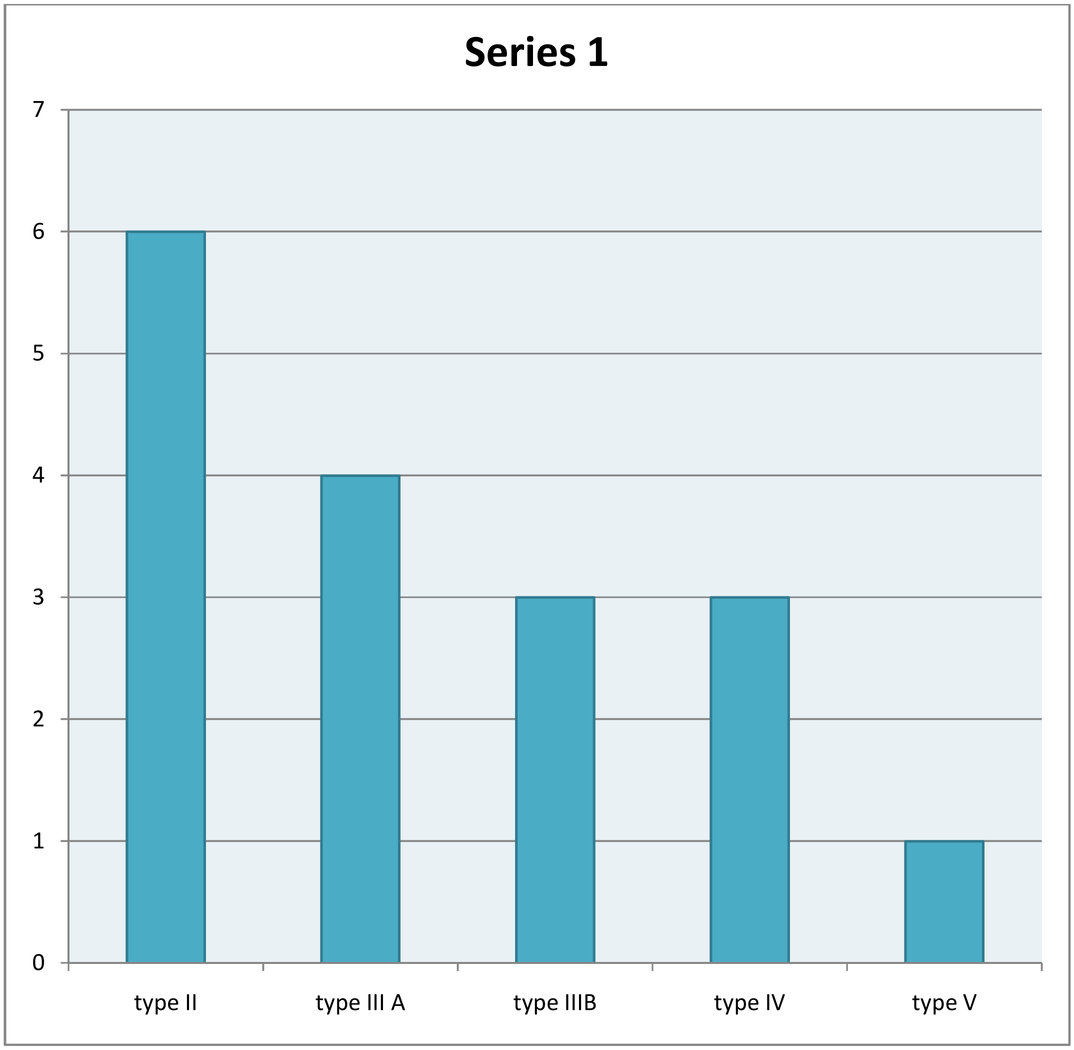
Nature of injury



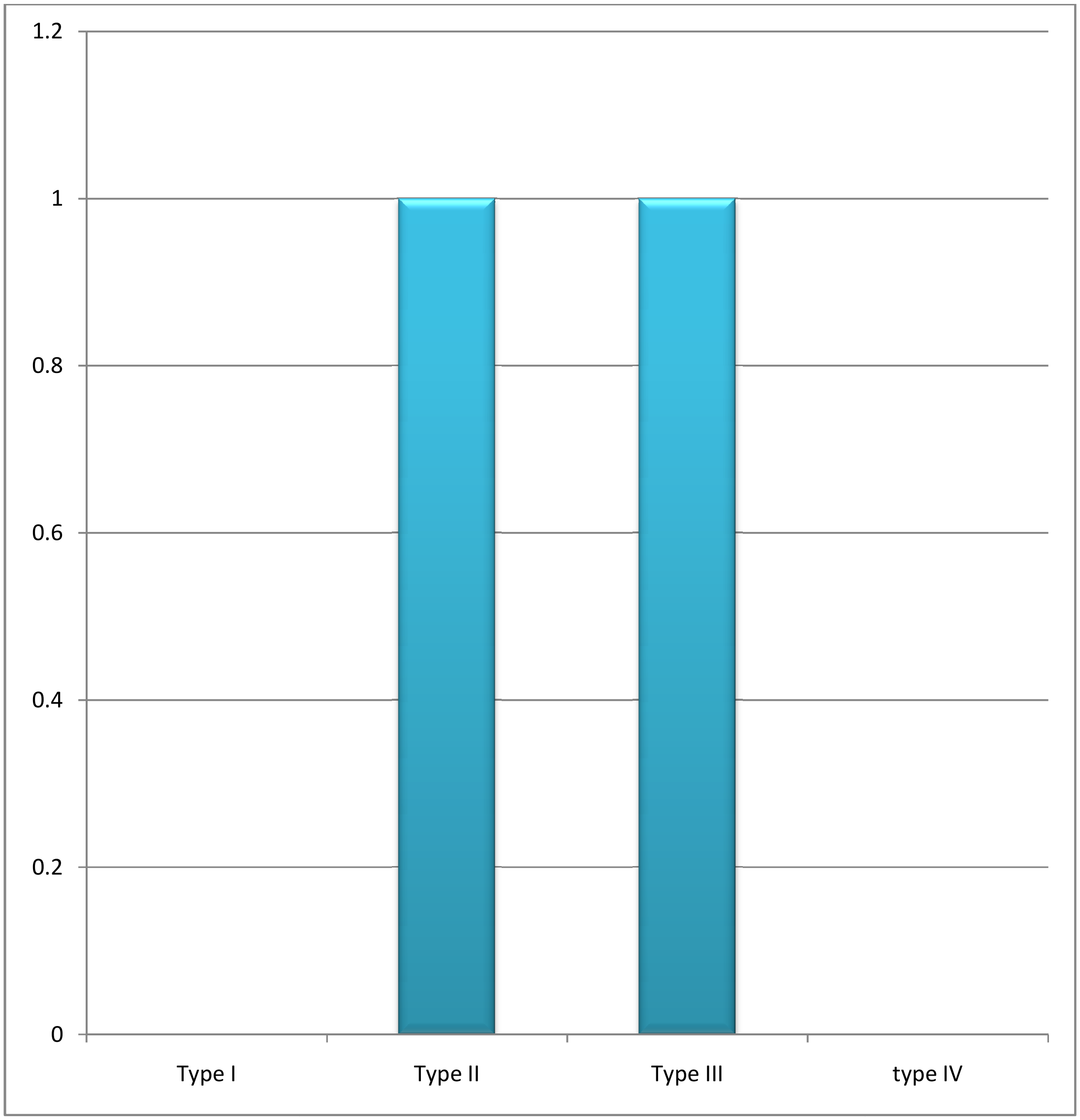
Side affected



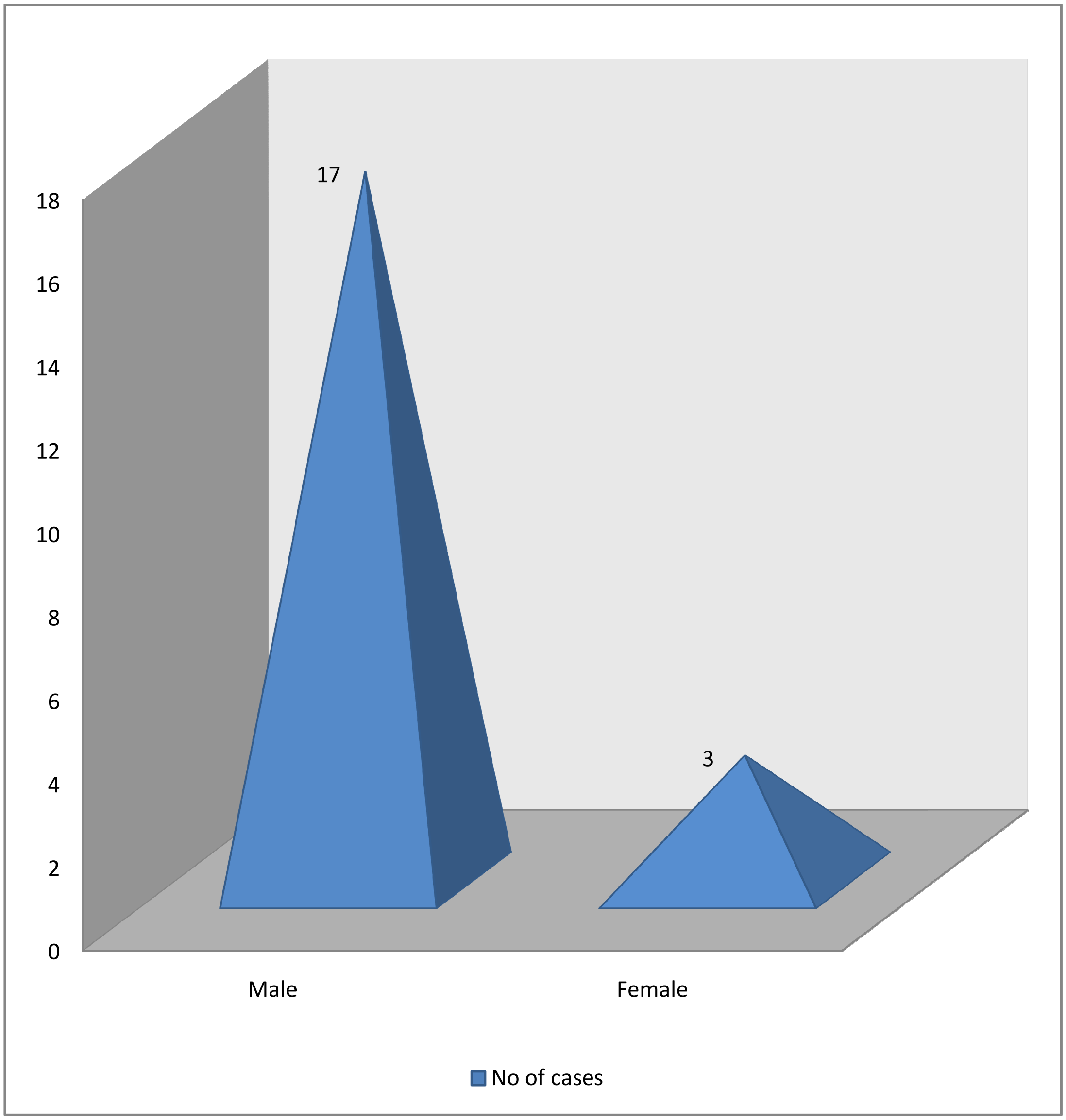
Type Of Fracture: SEINSHEIMERS CLASSIFICATION



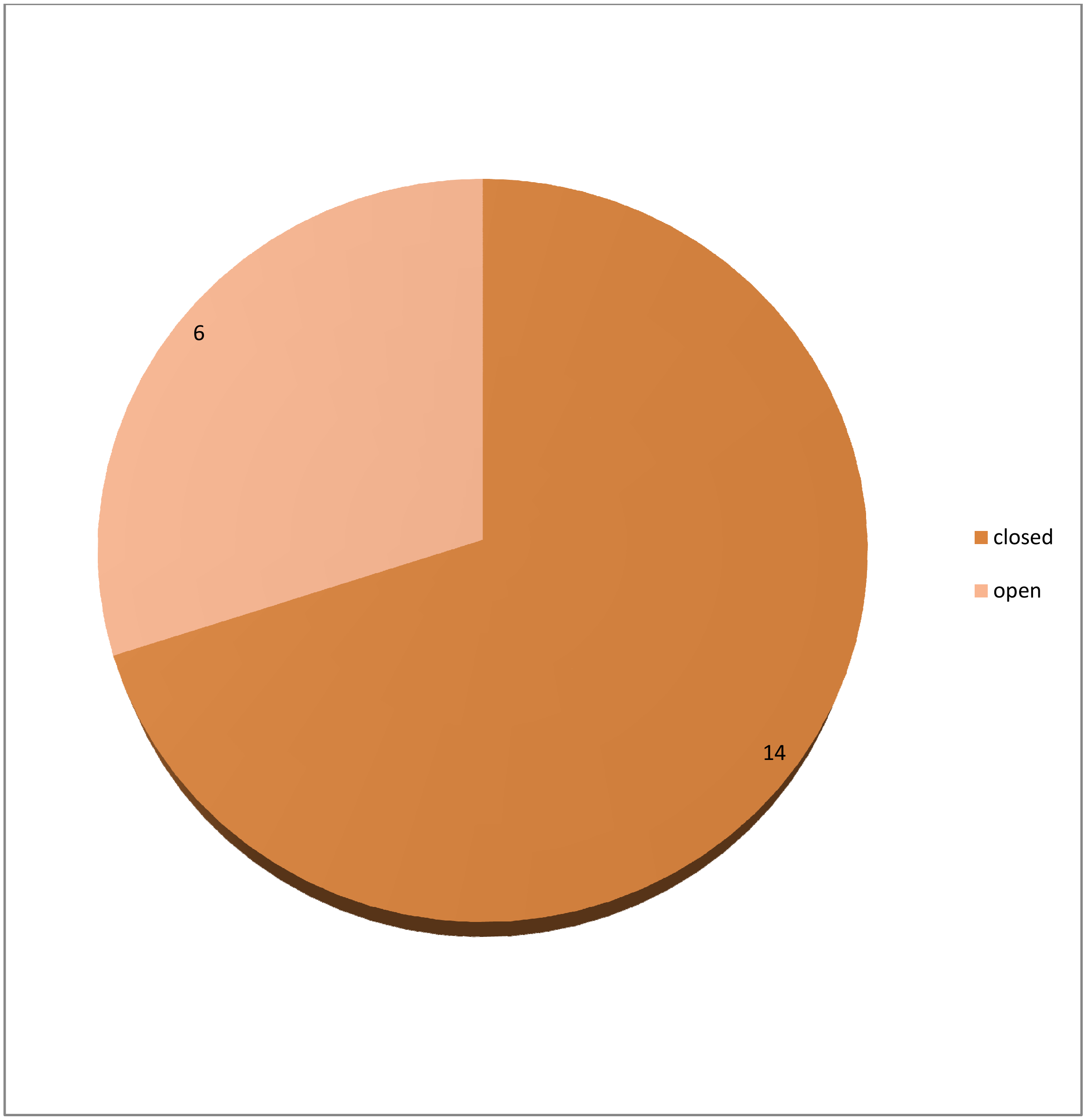
BOYD AND GRIFFIN TYPE



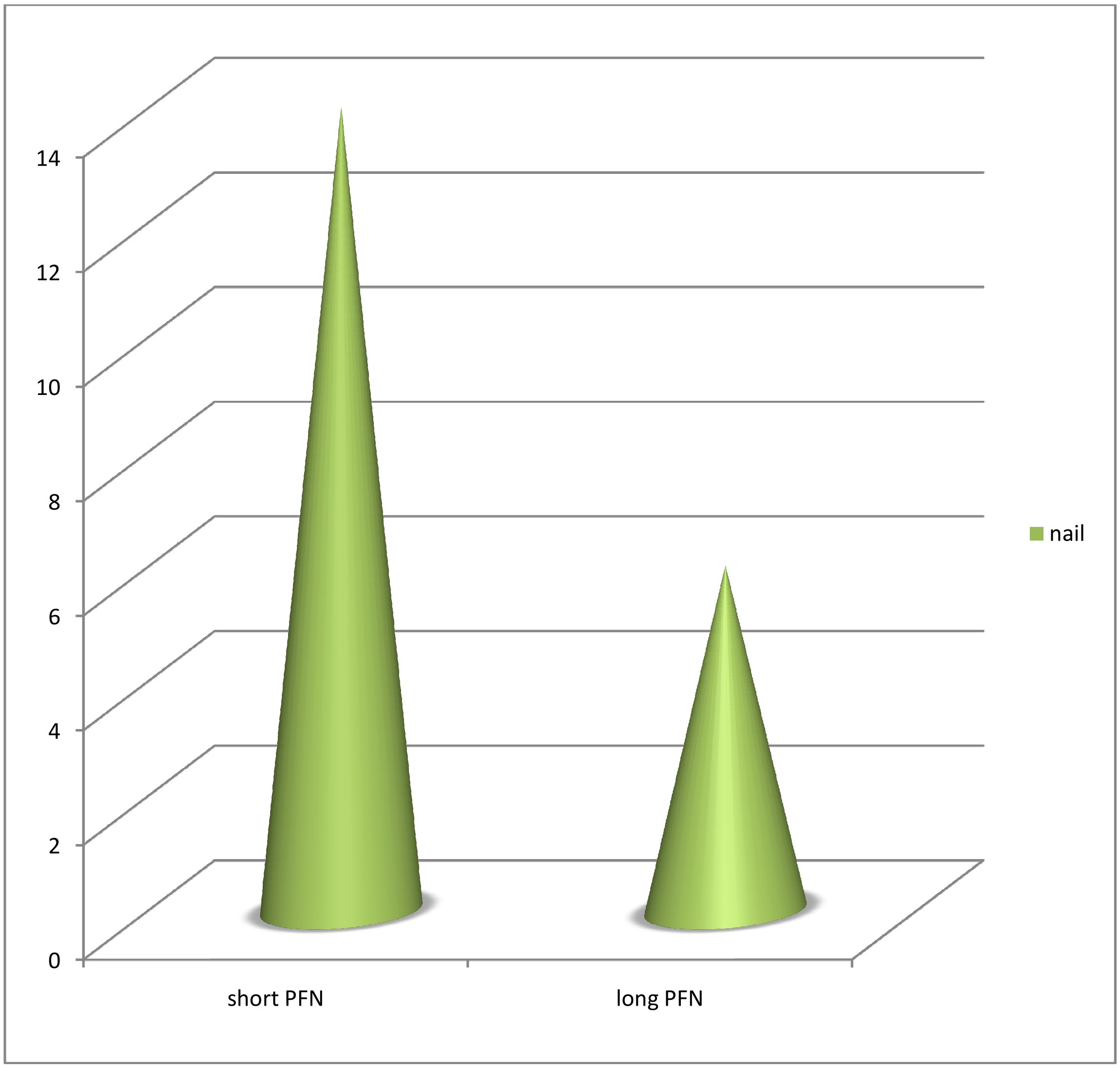
Sex Ratio



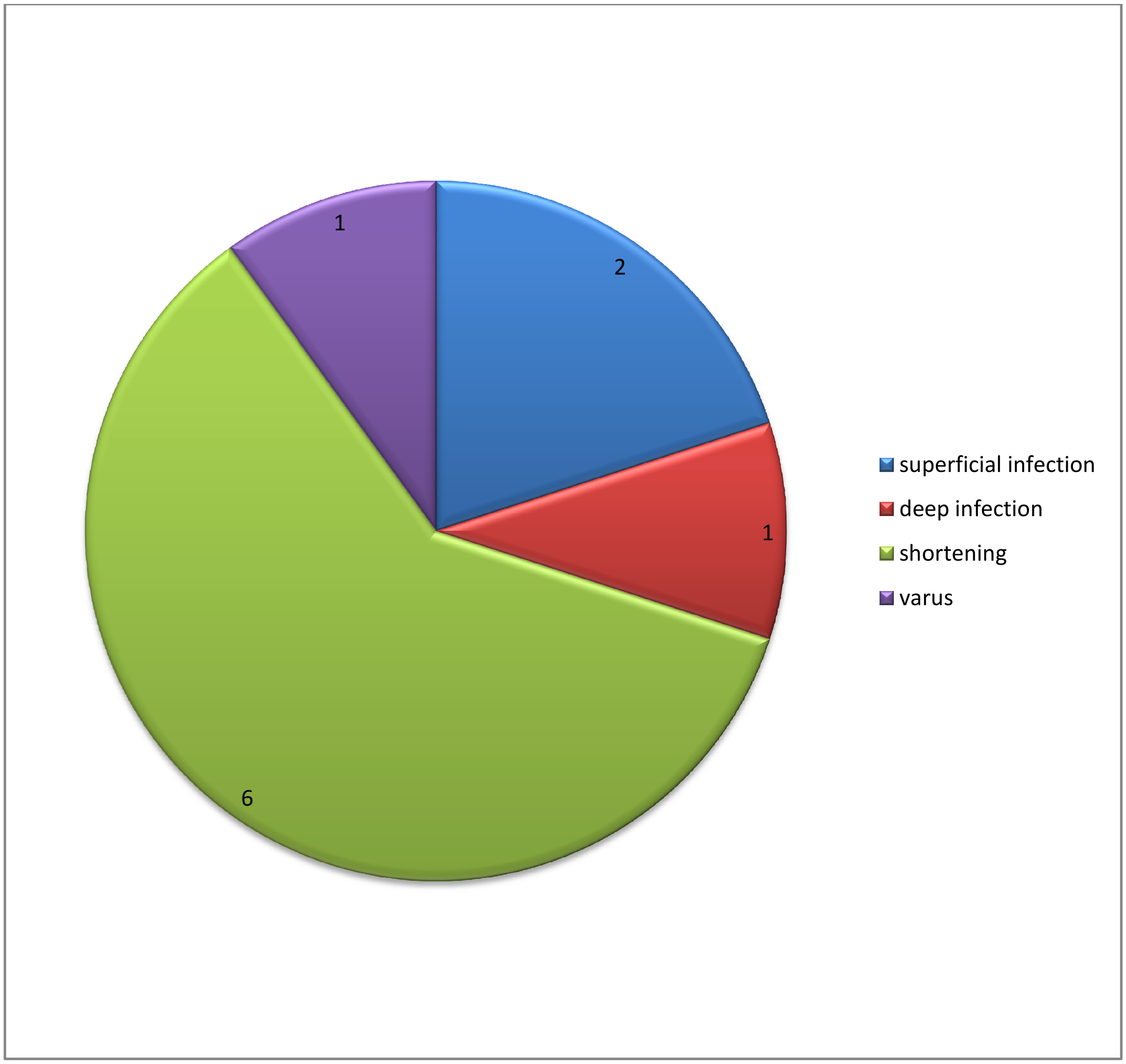
Reduction



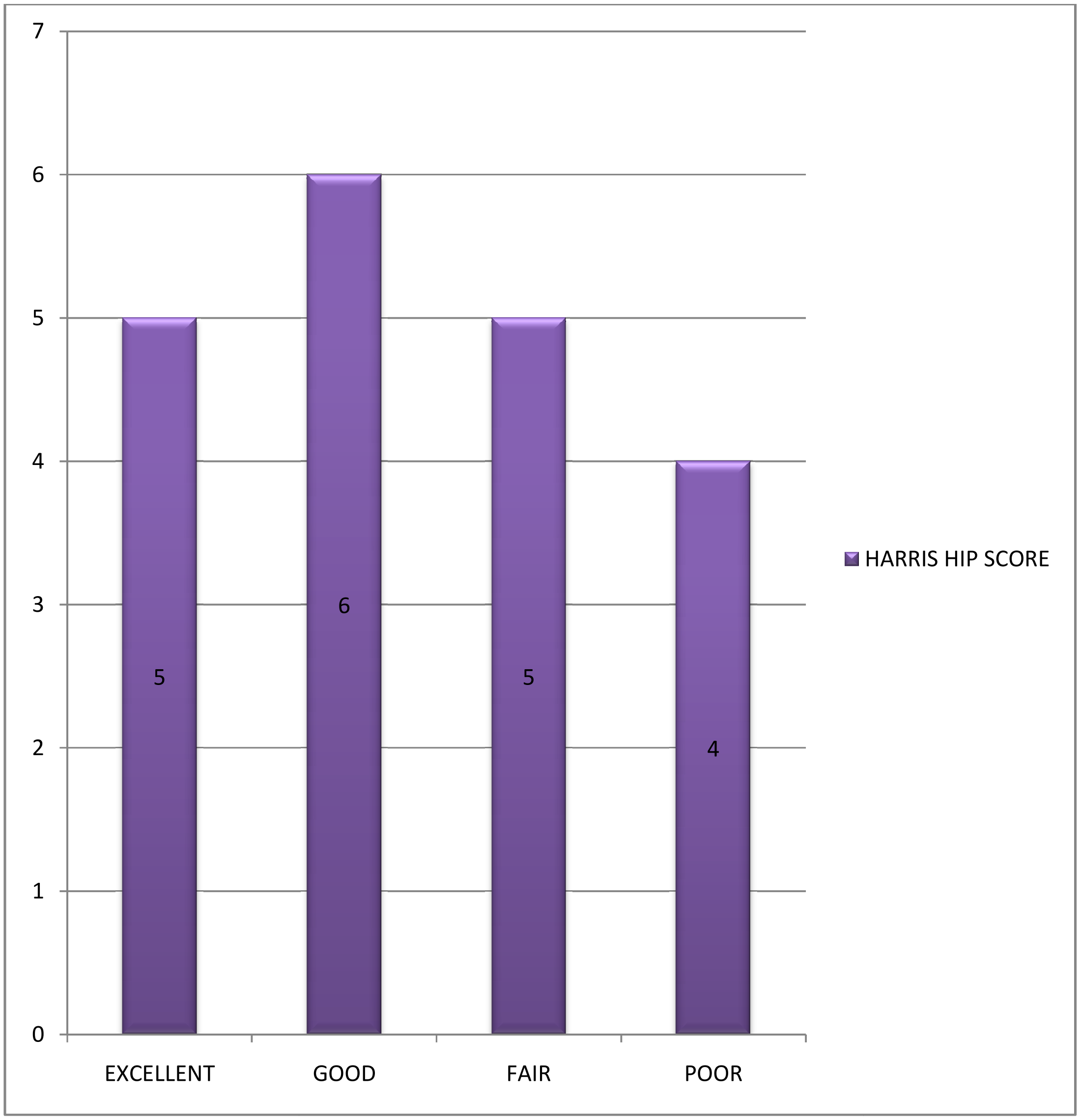
Nail



Complication



HARRIS HIP SCORE



DISCUSSION

Treatment of unstable trochanteric and sub trochanteric fractures remains always challenging.The bio mechanical forces,cortical bone with poor blood supply and deforming muscle forces all together leads to delay in fracture healing.This resulted in the introduction of various implants,which had both pros and cons.

Dynamic Hip Screw and Dynamic Condylar Screw have been used for a long time with great success.However both DHS and DCS requires relatively larger skin incision,more tissue handling,all of which increases the probability of infection,blood loss,operating time.Varus collapse of the fracture,non union and implant failure are also commonly seen.

In 1996 AO/ASIF came up with new cephalomedullary reconstruction nail with trochanteric entry port.This nail have shown to be biomechanically stronger than DHS fixation and other modalities of fixation.Moreover Proximal Femoral Nail have also reduced the chances of infection,blood loss,morbidity and patients were allowed early weight bearing.

W. M. Gadegone & Y. S. Salphale[17] ,in 2006, reported a study on Proximal femoral nail – an analysis of 110 cases of proximal femoral fractures with an average follow up of 2 year. Postoperative radiographs showed a near-anatomical fracture reduction in 90% of patients.. The fracture consolidated in 20 weeks. No perceptible shortening was noted. Of the patients, 7% had superficial infections which were controlled with antibiotics.In our study the post operative radiographs showed near anatomical reduction in 85 % of cases,the fracture consolidated in 16 weeks.We had significant shortening in 6 cases and in 2 cases we had superficial infections and in one we had deep infection,in whom we treated with i.v antibiotics.

Metin Uzun et al[18], in 2010, In a study of 40 patients reported Long-term radiographic complications following treatment of unstable intertrochanteric femoral fractures with the proximal femoral nail and effects on functional results.The mean Harris hip score was 84. Radiographic complications mainly included secondary varus displacement in nine patients (25.7%).Secondary varus displacement was due to cut-out of the proximal screws , screw loosening due to collapse of the fracture site, and reverse Z-effect.In our study we had a mean Harris Hip Score of 80.5.We had one case of varus displacement and one case of Z – effect.

Simmermacher et al[19] (2000),in a clinical multicentric study of pertrochanteric fractures with Proximal Femoral Nail reported , mean duration of surgery was 70 minutes and mean blood loss was 200 ml. The mean duration of hospital stay was 20.67 days; mean time for full weight bearing was 16.5 weeks.In our study mean duration of surgery was 90 minutes and the mean blood loss was 250 ml.Mean duration of hospital stay was 28 days.Full weight bearing was started after a mean period of 16 weeks.

T.Morihara et al [47](1999) reported that in his series of 87 cases of trochanteric and sub trochanteric fractures he used only Long Proximal Femur Nail to avoid any periprosthetic fractures later. However in our series we used Long Proximal Femur Nail in 5 cases and Short nail in 15 cases.We did not encounter any periprosthetic fractures.

I. B. Schipper et al[48] (2003) in his vast series of 400 cases compared Gamma nail vs Proximal Femur Nail for sub trochanteric fractures reported The intra-operative blood loss was lower with the PFN (220 ml v 287 ml). Post-operatively, more lateral protrusion of the hip screws of the PFN (7.6%) was documented, compared with the gamma nail (1.6%). Most local complications were related to suboptimal reduction of the fracture and/or positioning of the implant. Functional outcome and consolidation were equal for both implants.The results in our study were comparable.

MSG Ballal et al[49] (2006) in his series of 216 patients reported 8 cases had screw breakage .Out of which revision nailing has been done in 6 patients with cerclage cable.In 2 cases long nail inserted with bone grafting done.In our study we didn't encounter any screw breakage .Bone grafting was not done in any.

W.M.Gadegone et al (2013) in his series of 36 cases stated that Long Proximal Femur Nail is a favourable option for ipsilateral proximal femur and shaft fractures.In our study we encountered 2 patients with ipsilateral proximal femur and shaft fractures for whom we did Long Proximal Femur Nail, where the results were satisfactory.

Pavelka et al[28] in his series of 79 patients treated with long Proximal femur nail did closed reduction in 68 cases whereas in our series we used long proximal femur nail for 6 cases and did closed reduction in cases.

B Kanthimathi et al in his study of 50 consecutive patients with PFN fixations for subtrochanteric fractures observed intraoperative and postoperative complications.He identified intraoperative technical difficulties in four patients and six patients showed postoperative complications where as in our study we encountered difficulty in passing the derotation screw in two patients.

Deepinder Chaudhary in his study of 25 patients of pertrochanteric fractures also documented that difficulty in placement of neck screw was encountered in 4 cases. Secondary varus was noted in 3 cases and in 1 patient antirotational screw cut through was seen.However all fractures united well in all the patients.In our series we had difficulty in placement of antirotation screw in 2 patients,with secondary varus in one patient and screw cut through was seen in one patient.Also in many of our patients we found that the guide wire deviates away from the track at the level of comminution.

Ashutosh Goswami et al in his retrospective study of 30 patients operated with proximal femur nail for unstable trochanteric and sub trochanteric fractures reported that 74 % of the patients had excellent to good results.In our study we had 60 % of the patients with the same results.

Minos Tyllianakis[50] in his series of proximal femur nailing for extracapsular hip fractures for 40 cases had done closed reduction with minimal incision and minimal soft tissue dissection in all his cases,whereas we happened to do open reduction in 6 of our cases

Devdatta S Neogi[51] et al in series of 30 cases done proximal femur nailing for 5 cases of ipsilateral neck and trochanteric fracture,where as we encountered one such case and had good result.

In our study we found that the 135 degree angle nail was found to be less useful where as 130 degree nail was found to be best suited for Indian standard.

CONCLUSION

Proximal femur nail has widened the indication of intra medullary nailing for more complex fractures of the proximal femur.By doing closed reduction ,it offers a minimal soft tissue damage,preserves the fracture hematoma,decreased blood loss and reduces the operating time.

The proximal femur nail offers a stable fixation,minimizes the stress and allows early mobilization.It offers a superior stabilization than other currently used implants for such fracture.

It is mandatory that the fracture must be reduced anatomically with alignment of postero medial buttress before nail insertion as the nail doesnot do any spell.

Though complications were reported, still it holds good,with good surgical hands because the procedure is technically demanding and needs a steep learning curve.

Though the results in our study is promising,however it needs more evaluation,since the sample of study is small and it is non randomized.

BIBLIOGRAPHY

1. Alam AWK, Ostlere S. The MRI diagnosis and management of incomplete intertrochanteric fractures of the femur. J Bone Joint Surg Br 2005;87(9):1253-1255.

2. Fracture and Dislocation Compendium. Orthopaedic Trauma Association Committee for Coding and Classification. J Orthop Trauma 1996;10(Suppl 1):v-ix, 1-154.

3.Clawson DK. Trochanteric fractures treated by the sliding screw plate fixation method. J Trauma 1964;4:737-752

4.French BG, Tornetta P. Use of an interlocked cephalomedullary nail for subtrochanteric fracture stabilization. Clin Orthop 1998;348:95-100

5.Jewett E L.One-piece angle nail for trochanteric fractures. J Bone Joint Surg. 1 941; 23: 803-10

6. Smith-Petersen M. Treatment of fractures of the neck of the femur by internal fixation. Surg Gynecol Obstet 1937;64:287.

7. Boyd HB, Griffin LL. Classification and treatment of intertrochanteric fractures. Arch Surg 1949; 58: 853-66.

8. Evans E. The treatment of intertrochanteric fractures of the femur. J Bone Joint Surg Br 1949; 31: 190-203.

10.Dimon JH, Hughston JC. Unstable Intertrochanteric Fractures of the Hip. J Bone Joint Surg Am.1967;49A:440-450

11.Singh M, Nagrath AR, Maini PS. Changes in trabecular pattern of the upper end of femur as an index of osteoporosis. J Bone Joint Surg 1970; 52 A: 457-67.

12.Sarmiento A.Intertrochanteric fractures of the femur.150 degree-angle nail-plate fixation and early rehabilitation-A preliminary report of 100 cases. J Bone Joint Surg. 1963;45 A:7 06-22

13. Watson JM, Cramer KE, Karges DE. Comparison of the compression hip screw with the Medoff sliding plate for intertrochanteric fractures. Clin Orthop 1998(348):79-86

14.Mahonmed MN, Harrington IJ, Hearn TC. Biomechanical analysis of the Medoff sliding plate. J Trauma 2000;48:93-100

15.Chapman MW, Bowman WE, Csongradi JJ, et al. The use of Enders pins in extracapsular fractures of the hip. J Bone Joint Surg Am 1981; 63:14-28.

16.Lindsey RW, Teal P, Probe RA, Rhodas D et al. Early experience with a gamma nail for peritrochanteric fractures of the proximal femur. J Orthop Trauma 1991; 71: 1649-58.

17.Gadegone WM and Salphale YS. Proximal femoral nail – an analysis of 100 cases of proximal femoral fractures with an average follow up of 1 year. International Orthopaedics (SICOT). 2007;31:403–408.

18. Metin Uzun, Erden Erturer, Irfan Ozturk, Senol Akman, Faik Seckin and Ismail Bulent Ozcelik.Long-term radiographic complications following treatment of unstable intertrochanteric femoral fractures with

the proximal femoral nail and effects on functional results. Acta Orthop Traumatol Turc. 2009;43(6):457- 463

19. Simmermacher RKJ, Bosch AM and Van der Werken C. The AO ASIF-proximal femoral nail (PFN): a new device for the treatment of unstable proximal femoral fractures. Injury. 1999;30:327-32.

20.Lei-Sheng Jiang;Lei Shen;Li-Yang Dai. Intra medullary Fixation of subtrochanteric fractures with Long proximal femoral nail or Long Gamma Nail;Technical Notes and Preliminary Results;Ann Acad Med Singapore2007;vol 36 ; 821-826

21. Deepinderjit Singh, Rajesh Kapila, Rakesh Sharma, Evaluation of clinical outcome of subtrochanteric fractures of femur fixed with proximal femoral nail, Pb Journal of Orthopaedics Vol-XIII, No.1, 2012

22.Roberts CS, Nawab A, Wang M, et al Second-generation intramedullary nailing of subtrochanteric femur fractures: a biomechanical study of fracture site motion. J Orthop Trauma 2002;16(4):231-238.

23.Robinson CM, Houslian S, Khan LA. Trochanteric entry long cephalomedullary nailing of subtrochanteric fractures caused by low-energy trauma. J Bone Joint Surg Am 2005; 87(10):2217-2226.

24.Christian Boldin, Franz J. Seibert, Florian Fankhauser, Gerolf Peicha, Wolfgang Grechenig, et al. Proximal femoral nail (PFN) – A minimal invasive treatment of unstable proximal femoral fracture. Acta Orthopaedica 2003 Feb; 74(1): 53-8.

25.Pajarinen J, Lindahl J, Michelsson O, Savolainen V, Hirvensalo E. Pertrochanteric Femoral Fractures Treated With a Dynamic Hip Screw or a Proximal Femoral Nail. A Randomized Study Comparing Post-Operative Rehabilitation.The Journal of Joint and Bone Surgery (Br). Jan 2005; 87 (1):76-81.

26. Klinger HM, Baums MH, Eckert M, Neugebauer R. A comparative study of unstable per and intertrochanteric femoral fractures treated with dynamic hip screw (DHS) and trochanteric press plate Vs proximal femoral nail(PFN). Zentralbl Chir. 2005 Aug; 130(4): 301-6.81

27.Reska M., Veverkova L., Divis P., Konecny J. Proximal femoral nail (PFN)- A new stage in the therapy of extracapsular femoral fractures. SCRIPTA MEDICA (BRNO) 2006 June; 79(2): 115-22.

28.Pavelka T, Houcek P, Linhart M, Matejka J. Osteosynthesis of hip and femoral shaft fractures using the PFN-long. Acta Chir Orthop Traumatol Cech.2007 Apr; 74(2):91-8.

29.Ricci WM, Schwappach J, Tucker M, et al. Trochanteric versus piriformis entry portal for the treatment of femoral shaft fractures. J Orthop Trauma 2006;20(10):663-667.

30.Ramakrishnan M, Prasad SS, Parkinson RW, Kaye JC:“Management of subtrochanteric femoral fractures and metastases using long proximal femoral nail”. Injury 35:184–190, 2004.

31.S.Nuber ,T.Schoweiss and A.Ruter. “Stabilization of unstable trochanteric femoral fractures:dynamic hip screw with trochanteric stabilization plate Vs Proximal femoral nail” Journal of orthopaedic trauma vol 17(4) 2003,pp 316-317

32.Ely L Steinberg, Nehemia Blumberg, Shmuel Dekel “The fixion proximal femur nailing system: biomechanical properties of the nail and a cadaveric study” Journal of biomechanics38 (2005)63-68.

33.Rosenblum SF, Zuckerman JD, Kummer FJ, Tam bs. A biomechanical evaluation of the gamma nail. J Bone Joint Surg Br 1992; 74: 352-57.

34.Gautier E, Ganz K, Krugel N, et al. Anatomy of the medial femoral circumflex artery and its surgical implications. J Bone Joint Surg Br 2000;82(5):679-683.

35. David G Lavelle J. Fractures and dislocations chapter-52 in Campbell’s Operative Orthopaedics. Vol 1, 11th Edition, Canale ST and Beaty JH. (edts), Philadelphia; Mosby. 2008;3237-3308.

36.Seinsheimer F III. Subtrochanteric fractures of the femur. J Bone Joint Surg 1978;60A: 300-306

37.Russell-Taylor classification of subtrochanteric fractures. Skeletal Trauma 1998;2: 1891-1897.

38.Fielding JW, Magliato HJ. Subtrochanteric fractures. Surg Gynecol Obstet 1966;122: 555-569.

39. Kyle Richard F and Campbell Sara J. Intertrochanteric fractures, chapter-40 in Michael W Chapman Operative Orthopaedics. 1:600- 603.

40.Gotfried Y. The lateral trochanteric wall: a key element in the reconstruction of unstable pertrochanteric hip fractures. Clin Orthop Relat Res 2004(425):82-86

41.Baumgaertner MR, Curtin SL, Lindskog DM, Keggi J. The value of the tip- apex distance in predicting failure of fixation of peritrochanteric fractures of the hip. J Bone Joint Surg Am 1995; 77: 1058-64.

42.Kinast C. Bolhofner BR, Mast JW. GanzR. Subtrochanteric fractures of the femur: results of treatment with the 95-degree condylar blade plate. Clin Orthop 1989: 238:122-130.

43. Trafton PG.Subtrochanteric - intertrochanteric femoral fractures. Orthop Clin North Am 1987;18:59-71.

44.Roberts CS, Nawab A, Wang M, et al Second-generation intramedullary nailing of subtrochanteric femur fractures: a biomechanical study of fracture site motion. J Orthop Trauma 2002;16(4):231-238

45. Ely L Steinberg, Nehemia Blumberg, Shmuel Dekel. The fixion proximal femur nailing system: biomechanical properties of the nail and a cadaveric study. J of Biomechanics 2005; 38: 63-8.

46.Ostrum RF, Marcantonio A, Margurger R. A critical analysis of the eccentric starting point for trochanteric intramedullary femoral nailing. J Orthop Trauma 2005;19(10): 681-686.

47.T Morihara Department of Orthopaedic Surgery, Kyoto Prefectural Yosanoumi Hospital, Kyoto, Japan, Proximal femoral nail for treatment of trochanteric femoral fractures ,Journal of Orthopaedic Surgery 2007;15(3):273-7.

48. I. B. Schipper, E. W. Steyerberg, R. M. Castelein, University Hospital of Rotterdam, The Netherlands Treatment of unstable trochanteric

fractures randomised comparison of the gamma nail and the proximal femoral nail J Bone Joint Surg [Br] 2004;86-B:86-94

49.Ballal MS, Emms N, Thomas G. Proximal femoral nail failures in extracapsular fractures of the hip. J Orthop Surg (Hong Kong) 2008;16(2):146-149.

50.Minos Tyllianakis,Andreas Panagopoulos,Andreas Papadopoulos: Treatment of extra capsular hip fractures with the proximal femoral nail ;Long term results in 45 patients Acta Orthop Belg,2004,70,444-454

51.Devdatta S Neogi, K V Ajay Kumar, Vivek Trikha, Ipsilateral femoral neck and trochanter fracture Indian J Orthop. 2011 Jan-Mar; 45(1): 82,86

CASE ILLUSTRATIONS

CASE - 1

CASE - 2

CASE - 3

CASE - 4

CASE - 5

PROFORMA

NAME

AGE/SEX

IP NO

OCCUPATION

ADDRESS

CONTACT NO

DATE OF INJURY

DATE OF SURGERY

DATE OF DISCHARGE

MODE OF INJURY

CO –MORBID CONDITION

ASSOCIATED INJURIES

OPEN / CLOSED

CLASSIFICATION

ANAESTHESIA

OPEN / CLOSED REDUCTION

IMPLANT

BONE GRAFT

DURATION OF SURGERY

AMOUNT OF BLOOD LOSS

CHECK X-RAY

POST OP PROTOCOL

PARTIAL WEIGHT BEARING

FULL WEIGHT BEARING

FOLLOW UP	6 WEEK	3 MONTH	6 MONTH	1 YEAR
CLINICAL				
RADIOGRAPHY				
DEFORMITY				
ROM HIP JOINT				
FLEXION				
EXTENSION				
ABDUCTION				
ADDUCTION				
INTERNAL ROTATION				
EXTERNAL ROTATION				
VISUAL ANALOGUE PAIN SCALE				
HARRIS HIP SCALE				

MASTER CHART

S.NO	NAME	AGE/SEX	IP.NO	MODE OF INJURY	SIDE	Seinsheimer's	Boyd and Griffin
1	Amirtham	55/M	53125/13	Fall from height	RIGHT		II
2	Ramesh	30/M	61938/13	RTA	LEFT	III B	
3	Alagan	65/M	58761/14	Elephant attack	RIGHT	II B	
4	Rajan	42/M	16735/13	RTA	LEFT	III A	
5	Ramuthai	60/F	46269/13	RTA	LEFT	II C	
6	Prabhakar	20/M	47174/13	RTA	RIGHT	III B	
7	Saraswathi	60/F	60361/13	Slip and fall	LEFT	III A	
8	Arunagiri	35/M	36785/14	RTA	RIGHT	II B	
9	Salim	33/M	32341/14	Fall from height	RIGHT	IV	
10	Shanmugam	65/M	41420/14	RTA	RIGHT	III A	
11	Balasubramani	35/M	5309/14	Fall from height	RIGHT	IV	
12	Kalidas	47/M	4980/14	Slip and fall	RIGHT	III	
13	Prakash	32/M	15719/14	Fall from height	LEFT	II B	
14	Ramesh Kumar	35/M	61439/13	RTA	RIGHT	III B	
15	Rajamanikkam	45M	16731/13	RTA	LEFT	IV	
16	Umadevi	30/F	37460/14	RTA	RIGHT	V	
17	Markandeyan	62/M	4181/14	Slip and fall	LEFT		III
18	Vimal	40/M	31734/14	Fall from height	RIGHT	III A	
19	Lakshmanan	65/M	43123/13	Slip and fall	RIGHT	II	
20	Udayakumar	38/M	51763/14	Slip and fall	LEFT	II	

Implant (mm)	Reduction	OPERATIVE TIME(mins)	BLOOD LOSS(ml)	BLOOD TRANSFUSION(unit)	COMPLICATIONS	radiological union	Harris hip s
250 x 10	closed	90	200	1		12 weeks	Excelle
250 x 9	closed	60	150				Excelle
250 x 10	open	110	300			19 weeks	Fair
250x11	closed	80	250			15 weeks	Exce
250 x 10	closed	70	200		Shortening	18 weeks	Good
250 x 10	closed	80	200		Shortening	17 weeks	Goo
250 X 11	open	75	200	1	Shortening,Varus collapse	20 weeks	POOR
360 x 9	closed	75	250		Superficial infection	17 weeks	Fair
360 x 11	open	85	300	1	Shortening	19 weeks	Goo
250 x11	open	75	200		superficial infection	17 weeks	Fair
360 x 9	closed	90	250			Normal	Good
250 x 10	closed	90	350				Fa
250 X 9	closed	75	200			17 weeks	Excelle
250X 9	closed	70	200			16 weeks	Good
360 x 11	closed	90	350	1		18 weeks	Excelle

360 x 10	open	85	300	1	Shortening	14 weeks	Good
250 x 9	closed	90	300		Shortening	18 weeks	POOR
360 x 9	closed	100	380		Deep infection	20 weeks	POOR
250 x 10	closed	68	400			Normal	POOR
250 x 10	open	78	320			Normal	Fair

ஒப்புதல் படிவம்

பெயர் :

பாலினம் :

முகவரி : வயது :

அரசு கோவை மருத்துவக் கல்லூரியில் பொது மருத்துவ துறையில் பட்ட மேற்படிப்பு பயிலும் மாணவர் **மரு. சையத் பாக்கர்** அவர்கள் மேற்கொள்ளும் "**கோயமுத்தூர் மருத்துவ கல்லூரி மருத்துவமனையில் பிராக்ஸிமல் ∴பீமர் நெயில் ∴பார் அன்ஸ்டேபிள் ட்ரொகேன்ட்ரிக் ∴ப்ராக்ச்சர்**" – **(இடுப்பு மூட்டு எலும்பு முறிவுக்கு கம்பி மற்றும் திருகானி மூலம் அறுவை சிகிச்சை)** ஆய்வில் செய்முறை மற்றும் அனைத்து விவரங்களையும் கேட்டுக் கொண்டு எனது சந்தேகங்களை தெளிவுபடுத்திக் கொண்டேன் என்பதை தெரிவித்துக் கொள்கிறேன்.

நான் இந்த ஆய்வில் முழு சம்மதத்துடன், சுய சிந்தனையுடனும் கலந்து கொள்ள சம்மதிக்கிறேன்.

இந்த ஆய்வில் என்னுடைய அனைத்து விபரங்கள் பாதுகாக்கப்படுவதுடன் இதன் முடிவுகள் ஆய்விதழில் வெளியிடப்படுவதில் ஆட்சேபனை இல்லை என்பதை தெரிவித்துக்கொள்கிறேன். எந்த நேரத்தில் அந்த ஆய்விலிருந்து நான் விலகிக் கொள்ள எனக்கு உரிமை உண்டு என்பதையும் அறிவேன்.

இடம் : கையொப்பம் / ரேகை

நாள் :